Course Syllabus
Industrial Chemistry (CHE 380.63)
3 hours
Department of Chemistry Illinois State University

Instructor:

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Catalog Description: CHE 380.63 Industrial Chemistry

> CHE 250 or equivalent or cons inst req.
> Advanced study of physical inorganic chemistry in applied settings. Topics covered include industrial cooling processes, industrial catalysis, manufacturing and purification processes in applied settings. For credit only in the MCE/MSCE degree or for non-degree seeking students. No credit if the student has already taken another equivalent course.

COURSE OVERVIEW:

This course introduces the student to physical inorganic chemistry in applied settings. Students will review basic concepts from CHE 250 such as the structure and reactions of inorganic compounds and elements. They will then use these concepts to study phenomenon such as industrial cooling processes, industrial catalysis, manufacturing and purification processes in applied settings.

STUDENT OBJECTIVES:

Students completing this course will be able to...

1. Account for basic inorganic properties and processes, and to
2. Apply these properties and processes as they analyze and evaluate industrial and environmental uses of inorganic chemistry.

REQUIRED TEXT:

Chemistry, 11th Edition, by Chang and Goldsby, McGraw-Hill

REQUIRED STUDENT TASKS/ASSIGNMENTS:

The course will consist of self-study blocks, homework sets, chapter exams, and external search projects.

The homework sets will be made up of problems culled from both the text and those presented by the faculty. All problems will highlight particularly important aspects of the material covered.

Chapter exams will be comprised of substantive questions related to each chapter's focus. The focus will be chapter-by-chapter demonstrations of students' grasp of the topics at hand. A mid-term and final exam will not be used.

External search projects will be writing tasks of a brief presentation of the real-world application of selected chemical topics and principles studied in the text materials. That is, where/how can we see the chemical reactions and processes applied to the real-world of industrial manufacturing, public utilities, or everyday use of chemical technology and process? We want to see the reality of moving from the pages of the textbook to factual use in the day-to-day scene. These assignments would be general information searches or possibly an opportunity to actually visit a site of application (an elective option).

A detailed calendar of progress and study times will be issued separately.

Achievement in the course is measured with homework assignments, chapter exams, and external search writings:

Homework	400	(8 chapters x 10 questions x 5 points each)
Chapter Exams	400	(8 chapters x 10 questions x 5 points each)
External Searches	240	(8 assignments x 30 points each)

Total	1040 points	

Letter grades will be assigned based on either a straight scale or a curve.

All course materials can be found at: https://reggienet.illinoisstate.edu/xsl-portal

COMPETENCIES AND TECHNICAL SKILLS:

Taking an online course is a new, and very different, experience for most students. As such, you will find that some of the skills needed for success in a traditional classroom are not as useful and that a new set will need to be cultivated. Some of these are:

COMPETENCIES:

1. Time Management (self-discipline) -- Yes, this is also important in a traditional classroom, but even more so for an online course. The online version of CHE 380.63 will cover all of the same material that is covered in the traditional face-to-face course. You should plan to spend 15, or more, hours per week working on this course including regularly checking the course site. Also, because all course communications are asynchronous there can be a lag time of up to 24 hours (see below for details) between questions and answers. If you wait to the last moment to start an assignment, and get stuck, you may not receive an answer to your question until after the assignment is due. Start all work as soon as possible to avoid this.

2. Good writing skills -- Communicating scientific/mathematical concepts is extremely difficult to do, solely via text (imagine taking a calculus test when the only source of information is the textbook). Because a large number points earned in the course will be via partial credit it is crucial that the student must be able to clearly communicate their thought process for each answer. This applies to questions as well; the instructor can't properly answer a question that they don't understand. Sloppy writing skills will detract from full credit on all written assignments. An occasional misspelling or errant punctuation will not be a problem, but overall grammatical quality is expected. This is a post-graduate, college-level course, and writing quality is expected.

TECHNICAL SKILLS:

1. Consistent access to a multimedia capable computer and the internet -- Not a skill per say, but still a requirement for an online course. The computer should be able to play back most common multimedia file types (with sound). If possible, a web cam and associated software, such as Skype, is preferred but not required.

2. Familiarity with, and access to, commonly used web browsers and plugins/extensions.

ACADEMIC HONESTY:

All students are expected to adhere to the Illinois State University Code of Student Conduct, a copy of which can be found at http://deanofstudents.illinoisstate.edu/conflict/conduct/code/. Violations of this code may result in the instructor penalizing the student with a loss of points. The exact amount deducted is at the discretion of the instructor and will vary depending on the severity of the infraction and whether it is a repeat offense or not.

STUDENT ACCESS

Any student needing to arrange a reasonable accommodation for a documented disability and/or medical/mental health condition should contact Student Access and Accommodation Services at 350 Fell Hall, (309) 438-5853, or visit the website: StudentAccess.IllinoisState.edu.

TECHNOLOGY SUPPORT CENTER:

If you are having issues with the software listed in the previous section, technical support is available. ISU has 24/7 technical support available at http://helpdesk.illinoisstate.edu/. Please note that if your issue is not an emergency, and involves course materials, contacting the instructor first is most likely the best course of action. The ISU Helpdesk can help with software issues and account/ULID issues but there isn't much they can do if the instructor posts the wrong exam.

NETIQUETTE:

There will be an open-format Discussion Forum where members of the class can submit comments, questions, answers to those questions, suggestions, and general commentary about the course and topics encountered. To help guide online interactions, all facilitators and participants are expected to demonstrate appropriate netiquette, i.e. internet etiquette. That is, agree to interact in a positive, cooperative and supportive manner and display respect for the privacy and rights of others. This policy is inclusive of, but not limited to the following guidelines:

1. Keep all questions and comments relevant to the discussion topic. If another participant posts a comment or a question that is off topic, do not reply. A facilitator will reply in private to the participant.

2. Be courteous and treat colleagues with respect, modeling the same standards of behavior online you would follow in a face-to-face discussion.

3. Be respectful and open to opinions and ideas that differ from yours. Being deliberately hostile and insulting online, i.e. flaming or trolling, is not appropriate under any circumstance. When responding to messages or posts made by others, address the ideas not the person.

4. All course communication should be conducted in Standard American English to ensure understanding among diverse participants.

5. Note – the instructor reserves the right to remove posts that are not collegial or fail to meet netiquette guidelines.

OFFICE HOURS:

Since this is an on-line course, there will not be any physical meetings of the class as a whole, nor any face-time connections between the faculty and students. Thus, instead of holding office hours, student questions will be answered in one of two ways.

E-MAIL w/ THE FACULTY:

The instructor will answer all e-mail queries within 24 hours, often, well within 8-12 hours. To make this process work, ALL class related e-mail communications are **REQUIRED** to have the subject line starting with "CHE380.63" (without the quotes), followed by a hint of the content of the message. As an example: "CHE380.63 -- Question about enthalpy". This allows systematic filing of all communications in long-term retention to facilitate the retrieval of earlier messages, as needed. It is also best practice to reply on any given e-mail, not creating a new e-mail for returns on a message that was rec'd. This allows continuity of communication if a person needs to go back to any point of the exchange in an earlier e-mail -- don't want to have to flip back and forth between separate e-mails to capture information from earlier exchanges. And on the flip-side of this instruction, do not do the sloppy job of pulling up any old e-mail and doing a "Reply" on that old, unrelated topic without deleting the irrelevant information.

DISCUSSION FORUM BETWEEN STUDENTS:

ReggieNet includes a Discussion Forum for all class participants. The link is under Communication on the left hand side of the webpage. Quite often a classmate will have already resolved the same issue you have. If so they may be able to answer your question before the instructor does. Also, if multiple students have the same question, the instructor will post the answer here instead of e-mailing it to individual students.

APPROXIMATE ORDER OF MATERIAL:

The general scenario would be to assign chapter readings of the topics, followed by a round of textbook questions assigned to validate the basics of the academic presentations in the chapters – a basic run thru end-of-chapter questions and other assigned questions. But the bigger picture would be to see the applications of chapter materials in real-world process by developing a specific set of assignments for external pursuit (the *Advancing To* topics). The objective will be a call for 2-page to 4-page reports of the individual pursuits. We are not looking at dissertation-length studies and reports, just a presentation of the student's clear grasp of the application of textbook information in real-world settings, just a clear cut presentation of the student's grasp of the chemical/physical processes involved.

In the external work (the *Advancing To* topics), the process will be for students to conduct a literature searches for information and preparation of a brief presentation of his/her grasp of the application of the chemical principle. This is also an expectation that the students will endeavor to make direct, personal contact with people in the industry involved. The ultimate benefit would be if a student could make a personal visit to a local site that uses the chemistry studied. This local contact may not be a viable possibility for all students, based on their physical location and the location of an industrial process. But the requirement would be that the students must endeavor to seek out 2 to 4 opportunities to make a face-time visit to review the chemical processes used. Obviously, some of the topics would not be candidate for this opportunity (high altitude weather balloons, etc.), but several of the topics would lend themselves to face-time exposure.

CHAPTER READING ASSIGNMENTS:

Chapter 6	Thermochemistry
Chapter 13	Chemical Kinetics
Chapter 15	Acids and Bases
Chapter 17	Entropy, Free Energy, and Equilibrium
Chapter 18	Electrochemistry
Chapter 19	Nuclear Chemistry
Chapter 20	Chemistry in the Atmosphere
Chapter 21	Metallurgy and the Chemistry of Metals

EXTERNAL RESEARCH TOPICS and FOCUS POINTS:

Atmosphere -- Impact of volcanoes
Atmosphere -- Molecular velocities and densities/pressures at various altitudes
Atmosphere -- Details of the very high altitude matrix and the outer limit of the atmosphere
Atmosphere -- Lift capacity of balloons as a function of altitude
Atmosphere -- Temperature changes with elevation, and related chemistry/physical properties
Atmosphere -- Gas molecular velocity / collisions -- changes with altitude
Atmosphere -- Gas content percentages as a function of altitude
Atmosphere -- Gas content percentages at different latitudes (are there differences??!!)
Atmosphere -- States of water as vapor, colloidal particles, fog -- details
Ozone -- global production/depletion
Oxygen -- global production/depletion
Carbon Dioxide -- global production/depletion
Nitrous Oxides -- global production/depletion
Methane -- global production/depletion
Heat -- Combustion of methane/ethane/ethene/acetylene (Why is acetylene used for welding?)
Batteries -- Rxns/voltage/recharge process -- Iron/Phosphorus LFP
Batteries -- Rxns/voltage/recharge process -- Nickel/Manganese NMC
Batteries -- Rxns/voltage/recharge process -- Manganese LMO
Batteries -- Rxns/voltage/recharge process -- Titanate LTO
Batteries -- Rxns/voltage/recharge process -- Cobalt Oxide
Batteries -- Rxns/voltage/recharge process -- Ni/Cd
Batteries -- Rxns/voltage/recharge process -- Nickel/Metal Hydride
Batteries -- Rxns/voltage/recharge process -- Lithium ion
Batteries -- Rxns/voltage/recharge process -- Lithium Polymer
Batteries -- Rxns/voltage/recharge process -- Li/Fe
Batteries -- Rxns/voltage/recharge process -- Ni/Fe
Sacrificial anode process applied to underground iron piping for gas lines or water lines
Metals -- General process of zone refining
Metals -- General process of thermal refining
Metals -- Ore formula / refining / physical & chemical properties / recycling of Iron
Metals -- Ore formula / refining / physical & chemical properties / recycling of Aluminum
Metals -- Ore formula / refining / physical & chemical properties / recycling of Titanium

Metals -- Ore formula / refining / physical & chemical properties / recycling of Copper
Metals -- Ore formula / refining / physical & chemical properties / recycling of Zinc
Metals -- Ore formula / refining / physical & chemical properties / recycling of Gold
Metals -- Ore formula / refining / physical & chemical properties / recycling of Silver
Metals -- Ore formula / refining / physical & chemical properties / recycling of Nickel
Metals -- Ore formula / refining / physical & chemical properties / recycling of Chromium
Metals -- Ore formula / refining / physical & chemical properties / recycling of Tin
Metals -- Function and details of metals used in hip/shoulder/bone repairs
Water -- What is the net volume of water **molecules** in 1000 cm^3 of ice and in 1.000 L of liquid?
Water -- Dynamics, temperatures, and energetics of cooling of expansion for dewatering air
Water -- Details of dynamics and energetics of water at its triple point
Water -- Dynamics & process of desalination & reverse osmosis (pore size, pressure, efficiency)
Water -- Details of chemistry and processing of public drinking water (must have on-site visit)
Bromine -- Chemical process of collection of natural sources and concentration/purification
Chlorine -- Chemical process of collection natural sources and concentration/purification
Super-critical environments -- Details and dynamics
Cooling tower technology -- Dynamics and energetics
Cooling technology of computer motherboards and large servers
Gases -- Liquefaction of air and separation of O_2, N_2, and CO_2
Nitrogen oxides -- Formulas, chemical properties, sources, uses of different molecules
Radiowaves -- Range vs. wavelength or frequency
Radiowaves -- λ and υ of 1030 AM, 95.4 FM, 610 AM, and 88.7 FM
Laser light -- Dynamics and process of generating laser emissions
Chemical mfg -- Dynamics and process of commercial manufacturing of fertilizers
Chemical mfg -- Dynamics and process of commercial manufacturing of paint pigments
Chemical mfg -- Dynamics and process of commercial manufacturing of medicine
Liquid crystal media -- Details
Semi-conductor dynamics -- Details
Conductivity of mircro-size and nano-size conductors in printed circuit boards
Photovoltaic cells -- Details
Catalysts -- Details of modern industrial catalysis
Catalytic converters in automobile exhaust systems -- Details
Superconductors -- Details
Magnets -- Details of large industrial magnets
Sugar and salt -- Details of solubility/pptn of in purification processes
Electrical generation -- Nuclear reactor dynamics
Nuclear binding energy, as developed in the Hadron Collider experiments
Fission and fusion, as developed in the Hadron Collider experiments
Anodizing -- Process details and examples
Electroplating -- Process details and examples
Tensile strength -- Comparisons of VERY/ULTRA thin wires: Cu/Al/Fe/Au/Spider web
Electroplating -- Applications in mfr of printed circuit boards for computers
Galvanizing Process in mfr of highway guardrails, power poles, nails, nuts, bolts, etc
Sulfuric acid production
Sulfonic acid production
Nitric acid production
Hydrochloric acid production
Hydrofluoric acid production
Phosphoric acid production
Electrical resistance of metals in overland transmission lines

(Details of assigned topics and options of personal choice and assigned topics to be detailed in a separate communication.)