NET 230– Nuclear Chemistry

Engineering Technologies and Engineering Transfer

Catalog Course Description: This course is a study of basic nuclear plant chemistry including nitrogen reactions, lithium production, radio nuclides, chemical additives, filtration, ion exchange and related topics in nuclear chemistry.

Prerequisite(s): RDG 100, CHM 110 or CHM 100

Corequisite(s): None

Credit Hours:

	Credit Hours	Contact Hours
Lab	0	0
Lecture	3.0	3.0
Total	3.0	3.0

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Class Schedule: Section B80 TTh 3:55PM – 6:50PM

Office Hours: MW – 11:15 – 12:15 PM
TTH- 12:30 to 3:30PM

Textbook(s): Two PDF files provided by SCANA and two DOE PDF files. The files are available through desired to learn.

Other Required Material:

Course Objective:
Upon completion of this course the students should be able to understand basic chemistry principles important to the nuclear industry, describe the different mechanisms of corrosion and how to prevent them, describe the mechanisms and purposes of chemistry control in the primary and secondary plants, and to discuss the principles of demineralizers and Ion Exchangers.

This material is based upon work supported by the National Science Foundation under Grant No. 1104238. Any opinions, findings, conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Course Outcomes and Competencies:

Course Outcome:

Upon successful completion of the course the student should be able to describe basic applications of nuclear chemistry in a nuclear plant jobsite.

Course Competencies:

1. Describe basic chemical principles, write and balance chemical equations, and perform calculations including but not limited to molecular weight, molarity, normality and pH.
2. Describe the mechanisms of corrosion of metals used in nuclear power plants and the purposes and means of controlling these processes.
3. The student will be able to describe the mechanisms and purposes of chemistry control in the primary and secondary plants.
4. Discuss demineralizers and Ion Exchangers background and discuss industry and V. C. Summer related Demineralizer and Ion Exchanger events.

Course Attendance:

- Attendance will be recorded
    - 3 tardies = 1 absence
    - Missing 15% of total # of classes = W or WF (depending upon student's grade)
    - Class starts when lecture begins
- Absences due to appointments and other conflicts are expected; this is why students are allowed to miss up to 15% of the total number of class periods. If you miss a class for unavoidable reasons it is your responsibility to provide documentation to the instructor for your absence; however, the absence will still be counted as part of the 15% allowed during the semester. You should make an effort to inform the instructor ahead of time if you will miss class.
- If you are tardy for class, do not expect the instructor to notice that you have arrived. Either during the break or after class, it is your responsibility to inform the instructor that you arrived late.
- Having your personal property (e.g., book bags, books, etc.) in the room when role is taken is no guarantee that you will be counted present. If you are not in the classroom when role is taken you will be counted as absent or, if you come in after role, you will be counted late.
- You are responsible for any class material covered during your absence.
- If you must leave class early, you are expected to inform the instructor prior to the class

Withdrawal: Should the maximum allowable absences be exceeded prior to midterm, a "W" will be submitted to the registrar to be recorded on the student's transcript. Should the maximum allowable absences be exceeded after midterm, a "W" will be submitted to the registrar if the student was passing the course at the time of withdrawal OR a "WF" will be submitted if the student was failing the course at the time of withdrawal.

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Course Requirements: Students are required to submit work by the stated due date. Any work not submitted before the assignment is returned or graded will receive a zero (0) for that assignment.

Course Grading: The final course grade will be determined using the following rubric:

1. Written Report/Quizes 15%
2. Four Tests 60%
3. Final Exam 25%

Tests and the Final Exam cannot be made up. Other assignments may be submitted late for a penalty of 5% per business day (M-F). After assignments have been returned or solutions posted, late assignments will not be accepted.

Grading Scale:	90-100	A	Superior Work
	80-89	B	Good Work
	70-79	C	Average Work
	60-69	D	Below Average Work
	0-59	F	Unsatisfactory Work

Special Procedures: If special accommodations are needed for students with disabilities, the student should contact the Counseling Services Office for assistance. Documentation regarding a specific disability is required for accommodation arrangements. Confidentiality of the information received will be maintained.

Field Trips: None.

Classroom Rules/Other:
Students enrolled in the Electronic Engineering Technology degree program are expected to conduct themselves in a professional manner, respectful of the rights for all students and instructors and to exhibit the highest level of ethical behavior. The following standards (in addition to those standards described in the current academic catalog) are considered the minimal standards for successful professional achievement:

1. All students shall receive equal, just and fair treatment regardless of race, gender, religion or age. Loud, abusive and disrespectful language in the classroom can result in dismissal from the classroom and a possible withdrawal from the course.
2. Sexual harassment is prohibited.
3. Cheating on quizzes, exams or scheduled classroom work that is defined as 'independent work' by the instructor is prohibited.
4. Smoking, eating or drinking or the use of tobacco products is prohibited in the classrooms and the laboratories.
5. Theft or unauthorized removal of equipment or supplies from a classroom or lab shall result in withdrawal from the course as well as legal action to resolve criminal conduct.
6. Illegal copying of software from classroom or laboratory computers is prohibited.

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Course Topics Outline:
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(Note: Additional Assignments and Projects will be made as the semester progresses.)

1. Introduction to General Chemistry Principles (Module 1 from the DOE)
    i. Without references, **DESCRIBE** the characteristics of an atom.
    ii. Given an incomplete chemical reaction, **balance** the equation.
    iii. Know the principles of bonding including ionic versus molecular bond, types of forces involved in bonding and explain how elements combine to form chemical compounds.
    iv. State the Le'Chatelier principle
    v. Calculate molarity and normality.
    vi. Given information about a solution calculate pH and pOH.
2. Basics in pH measurements and the role of pH in the mechanism of corrosion.
3. Principles of oxidation reactions and describe the effect of corrosion particulate in the performance of the cooling system.
4. Describe the corrosion of selected metals common in industrial processes, the effect of corrosion in the heat transfer properties of the material and the effect of hydrogen production in the material properties.
5. Describe the mechanisms that cause corrosion including the different types of corrosion.
6. The handling of CRUD in the system.
7. Control of localized corrosion.
8. Concept of erosion and cavitation.
9. Sources of corrosion in the plant.
10. Description of isotopes formed in the reactor cooling system.
11. Describe the sources of tritium and how it is produced in the cooling system.
12. Limitations of different water purification systems due to organic contamination of the Reactor Coolant Systems and a description of the processes used for water purification.
13. Description of chemical additives added to different plant components.
14. **LIST** in order of ascending or descending preference the five possible conditions of a steam generator for chemistry control and describe each of them.
15. Technical specifications of chemical control and radiochemistry.
16. Description of the different demineralizers currently used in the nuclear industrial process.

PLEASE NOTE: Should change become necessary, the instructor reserves the right to adjust the requirements, pace, or scheduling of this course. Any change will be announced in class before it becomes effective.

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