Health Sciences 312

Radiation Science Fundamentals

T and Th 10:30-11:45 a.m. in JNSN B17
https://courses.pnhs.purdue.edu/hsci312/
August 24 to December 18, 2010 (end of semester)

Course Instructor

Ulrike Dydak, Ph.D. (udydak@purdue.edu)
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Office located in CIVL 1269

Course coordinator on the Indiana University (IU) Bloomington Campus: Susan B. Klein, PhD (sblklein@indiana.edu)

Teaching Assistants/Proctors

Purdue University: Samantha Similie (ssimilie@purdue.edu),
Mary Cherven (mcherven@purdue.edu),
Evan Wright (epwright@purdue.edu),
Christina Peace (cpeace@purdue.edu)

A summary of the days, times and locations when the teaching assistants, IUB coordinator and the instructor is available under the “Logistics, Course Schedule and Errata” sub-section of the course website.

Course Description

This course introduces principles and concepts related to radioactive decay, the interactions of ionizing radiation with matter, dosimetry and the human health effects of exposure to ionizing radiation. The course briefly reviews fundamental concepts related to atomic and sub-atomic physical processes as well as relevant aspects of modern physics, including selected aspects of the Special Theory of Relativity, wave/particle duality and the Heisenberg Uncertainty Principle. The course emphasizes critical thinking and problem solving skills over rote memorization, and students are expected to become proficient at manipulating the quantities and units used in the radiation sciences. Students are also expected to become adept at using critical thinking and problem solving skills to gain a deeper understanding of fundamental radiation science concepts. Students will gain practical experience and enhance their understanding of radiation protection by participating in radiological emergency response training.

Prerequisites: (Undergraduate level MA 16200 Minimum Grade of D- or Undergraduate level MA 16400 Minimum Grade of D- or Undergraduate level MA 16600 Minimum Grade of D- or Undergraduate level MA 16900 Minimum Grade of D- or Undergraduate level MA 17100 Minimum Grade of D- or Undergraduate level MA 17300 Minimum Grade of D- or Undergraduate level MA 18100 Minimum Grade of D-) and (Undergraduate level PHYS 15200 Minimum Grade of D- or Undergraduate level PHYS 17200 Minimum Grade of D-) or (Undergraduate level PHYS 16200 Minimum Grade of D- and Undergraduate level PHYS 16300 Minimum Grade of D-) or Undergraduate level NUCL 20000 Minimum Grade of C.
Course Objectives

Upon completion of this course, students should:

- Understand the major types of ionizing radiation and the approximate sizes and energies involved in physical processes on the atomic and sub-atomic scale (develop a “sense of scale” for the atomic and sub-atomic world)
- Understand the major types of radioactive decay, decay chains, the rates of particle emission, and the interactions of radiation with matter
- Understand and be proficient at manipulating the physical quantities and systems of units used in the radiological sciences, such as isotope half-life, activity, absorbed dose, linear energy transfer (LET), stopping power, range, fluence, fluence rate, quality factor and effective dose equivalent
- Understand the major health effects of exposure to radiation and be able to apply radiation protection principles (e.g., time, distance and shielding) to minimize the potentially harmful effects of exposure to ionizing radiation
- Be proficient at applying critical thinking and problem-solving skills to gain insight into the physical processes underlying the radiological sciences

Required Textbook


NOTE: Could manage with the 1st edition (J.K. Shultis and R.E. Faw, Fundamentals of Nuclear Science and Engineering, ISBN 0-8247-0834-2, Marcel Dekker, New York, NY, 2002. However, page numbers and content will differ somewhat. Also, the first edition had quite a few errata that are correct in the second edition.

The course will cover all or portions of the material presented in

- Chapter 1 Fundamental Concepts
- Chapter 2 Modern Physics Concepts
- Chapter 3 Atomic and Nuclear Models
- Chapter 4 Nuclear Energetics
- Chapter 5 Radioactivity
- Chapter 7 Radiation Interactions with Matter
- Chapter 8 Detection and Measurement of Radiation
- Chapter 9 Radiation Dose and Hazard Assessment

Students are responsible for, and may be tested on, all material covered in the lectures as well as material from the textbook. The lectures are designed to supplement, and not replace, the materials covered in the textbook. A list of additional textbooks, reports and journal articles related to the radiological sciences can be found in the “Related textbooks and other reading” document available on the course website.

IMPORTANT: Some sections of the exams may be closed book and closed notes and other sections may be open book and open notes. You will find having a copy of the textbook very useful on the exams. If you cannot find a copy of the textbook in a local bookstore, please immediately order one from an online bookstore such as Amazon.com or BarnesandNoble.com (or make other arrangements).
Websites

- Lecture materials, assignments, errata, grades, and related materials available at https://courses.pnhs.purdue.edu/hsci312/ (password required – Purdue Career Account)
- Radiological Science Frequently Used Sites at http://purcell.healthsciences.purdue.edu/FUS/

Course Schedule and Workload

Class meets in JNSN B17 on T and Th from 10:30 to 11:45 a.m. August 24 to December 19 (last lecture is on Thursday December 9). There will be seven homework assignments (due about once every two weeks), three 75 minute evening exams and a 2-hour cumulative final examination (week of Dec 13-18). Announced and unannounced extra credit quizzes may be periodically offered during class throughout the semester. Makeup exams will only be allowed when the reason for the absence is substantial and documented. Valid examples are: illness when documented by a note from a physician and documented attendance at a funeral. Makeup (extra credit) quizzes will not be offered for any reason. Late homework assignments will be accepted until the answer key is posted on the course website, which usually occurs within 48 hours after the assigned due date. Regardless, 20% of the points possible on an assignment will be deducted per day (any time after the assigned due date/time is “late”). Students should expect to spend approximately 4-6 hour per week outside of class reading the textbook, completing the homework assignments and studying for exams.

Please refer to the HSCI 312 Course Schedule, which is available under the Logistics, Errata and Assignments sub-section of the course website (https://courses.pnhs.purdue.edu/hsci312/), for a week-by-week outline of the lecture schedule and assignment and exam due dates. Lecture, assignment and exam dates may be adjusted at the discretion of the instructor. Revised due dates will be announced in class, and a revised version of the schedule will be posted on the course website.

Grading

Philosophy: As of the first day of class, everyone has an A. All students that demonstrate mastery of the concepts and topics covered in this course will receive an A in the course, i.e., final grades will not be assigned so that only a fixed number (%) of students receive an A or B or C. To demonstrate mastery of the material, students are required to complete a series of inter-related homework assignments, activities and exams. The homework assignments are designed to help students prepare for the exams, although portions of the exams may relate to concepts discussed during class or the textbook. Active participation in the radiological emergency response training is required.

Preparation of Homework Solutions: Guidance and grade criteria for the preparation of homework solutions are described in the “How to write-up homework solutions” document available on the course website (https://courses.pnhs.purdue.edu/hsci312/). Completing and understanding all of the assigned homework problems is critical to success on the exams. Do not memorize specific answers/numbers; instead learn the methods, concepts and procedures needed to solve the homework problems. Be prepared to solve similar types of problems on exams (and extra credit quizzes, when offered).

<table>
<thead>
<tr>
<th>Grade</th>
<th>Overall Score (%)</th>
<th>Scholastic Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>95.00 – 100.00</td>
<td>4.00</td>
</tr>
<tr>
<td>A</td>
<td>92.50 – 95.00</td>
<td>4.00</td>
</tr>
<tr>
<td>A-</td>
<td>88.50 – 92.50</td>
<td>3.70</td>
</tr>
<tr>
<td>B+</td>
<td>85.00 – 88.50</td>
<td>3.30</td>
</tr>
<tr>
<td>B</td>
<td>81.00 – 85.00</td>
<td>3.00</td>
</tr>
<tr>
<td>B-</td>
<td>77.00 – 81.00</td>
<td>2.70</td>
</tr>
<tr>
<td>C+</td>
<td>73.00 – 77.00</td>
<td>2.30</td>
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<tr>
<td>C</td>
<td>69.00 – 73.00</td>
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<tr>
<td>C-</td>
<td>65.00 – 69.00</td>
<td>1.70</td>
</tr>
<tr>
<td>D+</td>
<td>61.00 – 65.00</td>
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</tr>
<tr>
<td>D</td>
<td>57.00 – 61.00</td>
<td>1.00</td>
</tr>
<tr>
<td>D-</td>
<td>53.00 – 57.00</td>
<td>0.70</td>
</tr>
<tr>
<td>F</td>
<td>- 53.00</td>
<td>-</td>
</tr>
</tbody>
</table>
Specifics: The three in-class exams count for 20% of the final grade (60% total), the final exam counts for 20%, and the homework assignments count for 20%.

Letter grades will be assigned according to the range of scores shown in the table to the right. An example showing how to compute a weighted (final) score is shown on the next page.

Grade information will be posted on the course website (https://courses.pnhs.purdue.edu/hsci312/). A valid user account and password are required to access grade information. The username and password used to login to the site are the same ones used to login to your Purdue Career Account.

Grades Example

<table>
<thead>
<tr>
<th>Opportunity</th>
<th>Weight</th>
<th>Score</th>
<th>Weight x Score</th>
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</thead>
<tbody>
<tr>
<td>Homework</td>
<td>0.20</td>
<td>95.0</td>
<td>19.00</td>
</tr>
<tr>
<td>Exam 1</td>
<td>0.20</td>
<td>75.0</td>
<td>15.00</td>
</tr>
<tr>
<td>Exam 2</td>
<td>0.20</td>
<td>85.0</td>
<td>17.00</td>
</tr>
<tr>
<td>Exam 3</td>
<td>0.20</td>
<td>92.0</td>
<td>18.40</td>
</tr>
<tr>
<td>Final Exam</td>
<td>0.20</td>
<td>94.0</td>
<td>18.80</td>
</tr>
</tbody>
</table>

Final Score = 88.20 B+

Attendance Policy

Attendance is STRONGLY encouraged but not required. Although the topics covered in the textbook and course lectures will have considerable overlap, some materials covered in the lecture are not covered in the textbook and vice versa. Students will be responsible for, and may be tested on, materials from the textbook and the lectures. Skipping lectures and/or not reading the textbook will have a negative impact on your final grade.

Campus Emergencies

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. Students will be notified by email in the event of a change to the course. Information about changes to the course will also be posted at https://courses.pnhs.purdue.edu/hsci312/

Cheating Policy

The instructor expects that no student will cheat on exams or quizzes. In the unfortunate event that cheating occurs, the grade for the exam/quiz in question will be assigned an F (0%) and the cheating incident will be reported to the Dean of Students.