Syllabus
Techniques in Radiation Dosimetry
ERHS 632
Fall
MRB119

Course director and instructor: Tom Johnson
Instructor Contact Information: tj@colostate.edu, 491-0563
Office Hours: M-F 0800-0900 and by appointment
Class hours: 0830-1000 (section 1) 1100-1300 (section 2) Tuesdays
Classroom: MRB 119

Textbook(s): G.F. Knoll, Radiation Detection and Measurement (Required)

You will be REQUIRED to seek outside references for this class but you are not required
to purchase these references. They are all available from the library or on special loan
from the instructor. The references include, but are not limited to:

Cember: Introduction to Health Physics by Herman Cember
Gollnick: Basic Radiation Protection Technology by Daniel Gollnick
NCRP: NCRP Report 130, 125, 122, 112, 106, 101, 95, 94, 93 and others.
ICRU: International Commission on Radiological Units
Moe: Operational Health Physics by H.J. Moe (Published by DOE)
MARSSIM: Multi-Agency Radiation Survey & Site Investigation Manual

Course Objectives
Upon successful completion of this course, the student will be able to [course objectives
should support HP educational objectives and outcomes. Delineate which educational
objective or outcome is supported by each class objective]:

- Obtain practical experience in solving applied health physics problems
- Apply knowledge of health physics and statistics
- Form a hypothesis, design and conduct experiments, and analyze and interpret
data
- Identify and solve health physics problems
- Use techniques and skills, modern scientific instrumentation necessary for
  professional practice
Class Schedule
(Note: This schedule is tentative, and subject to change, depending on availability of equipment and sources.)

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Topic</th>
<th>Reading</th>
<th>Instructor</th>
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</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>1</td>
<td>Using portable ion chambers to determine dose.</td>
<td>Knoll, Gollnick</td>
<td>Johnson</td>
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<tr>
<td>Week 2</td>
<td>2</td>
<td>GM Tube dose measurements</td>
<td>Knoll, Gollnick</td>
<td>Johnson</td>
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<tr>
<td>Week 3</td>
<td>3</td>
<td>TLD 100, 200 lab</td>
<td>Attix</td>
<td>Johnson</td>
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<tr>
<td>Week 4</td>
<td>4</td>
<td>TLD 600, 700 (prep)</td>
<td>Attix</td>
<td>Johnson</td>
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<tr>
<td>Week 5</td>
<td>5</td>
<td>TLD 600, 700</td>
<td>Attix</td>
<td>USGS Reactor</td>
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<td>Week 6</td>
<td>6</td>
<td>Fricke Dosimetry</td>
<td>ASTM Standard</td>
<td>Johnson</td>
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<tr>
<td>Week 7</td>
<td>7</td>
<td>VTC dosimetry (TBA)</td>
<td>TBA</td>
<td>TBA</td>
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<td>Week 8</td>
<td>8</td>
<td>Midterm exam</td>
<td></td>
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<tr>
<td>Week 9</td>
<td>9</td>
<td>Calculating modified DAC and ALI’s</td>
<td>10CFR20</td>
<td>Johnson</td>
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<tr>
<td>Week 10</td>
<td>10</td>
<td>Internal Dose measurement using a whole body counter</td>
<td>Knoll, Gollnick</td>
<td>Johnson</td>
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<td>Week 11</td>
<td>11</td>
<td>Performing dose estimates using basic and new references Water sample doses</td>
<td>Cember</td>
<td>Johnson</td>
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<tr>
<td>Week 12</td>
<td>12</td>
<td>Bioassay or urine sample (C-14)</td>
<td>Cember, Gollnick</td>
<td>Johnson</td>
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<tr>
<td>Week 13</td>
<td>13</td>
<td>Radon interference with air sampling, atmospheric inversions and dose</td>
<td>Cember, Gollnick</td>
<td>Johnson</td>
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<td>Week 14</td>
<td>14</td>
<td>ESR dosimetry</td>
<td>ASTM Std.</td>
<td>Johnson</td>
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<tr>
<td>Week 15</td>
<td>15</td>
<td>Presentations</td>
<td></td>
<td>Students</td>
</tr>
<tr>
<td>Week 16</td>
<td>16</td>
<td>Final exam</td>
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Grading
- A = 90%
- B = 80%
- C = 70%
- D = 60%
- F = < 59%
Lab:
Experiments will be performed usually in groups of two or four. You should choose a laboratory partner. For most laboratory periods there will be a brief discussion and explanation of the experiment to be performed. A quiz may also be given at the beginning of each laboratory period covering last week’s lab (or a lab in which no quiz was given). There MAY be some experiments or parts of experiments that cannot be adequately done as a group within the scheduled laboratory period. For these, you and your partner (or small group) will need to schedule a time during the week to do the work (when I am also available). The extra time spent outside of the scheduled laboratory will be compensated one way or another. In some instances, there will be weeks without labs, or small groups will alternate between weeks to perform labs due to insufficient numbers of instruments.

This course will adhere to the CSU Academic Integrity Policy as found in the General Catalog (http://www.catalog.colostate.edu/FrontPDF/1.6POLICIES1112f.pdf) and the Student Conduct Code (http://www.conflictresolution.colostate.edu/conduct-code ). At a minimum, violations will result in a grading penalty in this course and a report to the Office of Conflict Resolution and Student Conduct Services.

Grades:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tr>
<td>Weekly pre-class “pop” Quizes</td>
<td>10%</td>
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<tr>
<td>Lab Reports</td>
<td>40%</td>
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<tr>
<td>Mid term exam</td>
<td>15%</td>
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<tr>
<td>Final Exam</td>
<td>15%</td>
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<tr>
<td>Summary Paper/presentation</td>
<td>10%</td>
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<tr>
<td>Attendance/participation</td>
<td>10%</td>
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Lab attendance is mandatory. See me if it is necessary for you to miss a lab for any reason. Labs can not be made up unless permission is obtained prior to the lab. The following rules apply to absences and late reports:

1. Excused absentees may hand in their reports 1 week after the original due date without penalty.
2. Those who submit reports more than one week late will have their FINAL grade for the class reduced to a “C” OR LOWER.
3. If you do not submit a report for every class requiring a report you will automatically FAIl THE CLASS.

Lab Reports:
Each student is required to submit a report for each lab performed. Lab reports are due one week after the experimental work is completed. They are to be handed in at the beginning of the next lab period. If a student forgets to bring in the lab report to class, it may be submitted by the end of the day (4:00 PM MST) without penalty. The report should be submitted directly to me either electronically or on paper. Late labs will be penalized one letter grade per 24 hour period late into my hands. This means if I leave town for two days and you are only one day late your grade will STILL be reduced by two letter grades unless submitted via email with a verifiable time stamp.
Lab reports should be neat, organized, and concise. Your reports must be typed, except where impractical. YOU WILL BE GRADED on grammar, spelling, and ability to communicate! Although this may not be an English class, written communication has been identified as an area of weakness with health physics students.

The Lab report format will follow that of a journal article:

1) A title sheet that contains:
   a. title of the experiment
   b. day and date of experiment
   c. lab section
   d. your name (lead author)
   e. partner’s name when working in pairs (co-authors)

2) Abstract
3) Introduction
4) Materials and Methods
5) Results
   a. Neatly tabulated data
   b. Calculations whenever necessary
   c. Graphs if necessary
   d.

6) Discussion
   a. Answers to questions, if any, on the information sheet
   b. Comments or reasons for anomalous data obtained

7) Conclusion
8) References

Note that lab reports will be graded based not only on scientific content, but also on grammar, citations used, quality of graphics and tables, and proper use of the English language! Note that poor writing may result in a very poor grade! Avoid using the word “this” in all reports.

You may work on the reports with your lab partners, and you MAY submit a single report with your lab partner BUT you will both get the same grade for the report and both names must appear on the report! Exams will NOT be given with lab partners, you must take all exams without any outside help whatsoever. For take home exams, you may feel free to use any reference materials that are available. If you choose to excerpt any information in your report, I expect you to reference it properly, especially if it is from the world wide web. Plagiarism will not be tolerated, and will be considered cheating. If you would like to reference more than a sentence or two, consider attaching the appropriate article or attaching the relevant information from the web to your report, rather than misleading anyone as to the authorship.

This class (and labs) requires students to seek references outside the textbook. The use of reference books such as ICRP 38, the CRC Handbook, The Radiological Health Handbook, and ICRP 23 will be necessary to complete the homework problems

You will be REQUIRED to read assignments as well as the lab PRIOR to class and be prepared to conduct experiments at the start of class.
A QUIZ may be held immediately upon the start of each class the covers the reading materials. Additional “Pop” Quizzes may be administered on an ad hoc basis and will be averaged into the pre-class quizzes. The quizzes and exams may be written, ORAL, PRATICAL or some combination of all three. All materials are cumulative, so exams, quizzes, labs and any other work will require that you recall and understand ALL previous materials.

Cheating will not be tolerated. The first time you are caught cheating you will get a ZERO for the task (exam, quiz, plagiarism on a paper or any other task). Integrity is the cornerstone of all health physics and any infraction, however slight, is not excusable for any reason. If another is found to be complicit in cheating, they too will receive a zero. If you are discovered to be cheating a second time you will receive a failing grade for the class. The Course Director will make the determination if a student has been cheating.

**Summary Paper and Presentation**

A summary paper and presentation is due at the end of class. It must be typed or sent electronically and the presentation will be for the entire class. The presentation will be 10 minutes long and cover the same material as specified for the paper. It should be formatted and prepared as for a scientific conference. The paper will cover the following:

Information required for each system

1. Description of the basic detection process (how ionizing radiation reacts with system) and what it can detect.
2. What is the useful range?
3. What is the accuracy/precision?
4. Is there a max/min dose (or dose rate) for the system?
5. Where/how would this device best be utilized?
6. What are some limitations, advantages and disadvantages (list at least one).

Systems to discuss

1. Exo-electron dosimetry
2. Extrapolation chambers
3. Digital pocket dosimeters
4. GAF Chromic film
5. OSL
6. Bubble Dosimeters
7. Sulfur pellets/Indium foils

Please notify the instructor which system you choose to present prior to the 4th week of class, so there is no duplication. Failure to pick a topic prior to week 4 will result in a zero for the presentation portion of the class. You can choose from the following systems, or pick an additional system with instructor approval.
Format of Lab Reports (example) See also the Health Physics Journal for format – your lab reports should look like a journal article when complete.

Title
Authors

Abstract (250 words maximum)

Statement of hypothesis and/or goal. Summary of materials and methods. Results. Discussion. Conclusion.

Introduction
Statement of hypothesis. Background on how the system works. Describe at least one other potential method(s) of detection, their advantages and disadvantages. State why system in this report is better/worse and support the hypothesis. Statement on if failed/confirmed hypothesis.

Materials and Methods
Comprehensive description of all equipment used for the lab. Include diagrams and photos as necessary. Comprehensive description of methods used – use complete sentences and NOT an outline!

Results
List your results here ONLY and analysis. It may consist of only tables, and brief descriptions of the tables.

Discussion
The discussion of what your data means belongs here. How did the data meet/not meet the needs of the hypothesis.

Conclusion
A brief summary of what you found, perhaps some generalizations, and a comparison with other equipment.

References
Use proper format and reference everything necessary.