

South Plains College-Reese Campus  
Course Syllabus

COURSE: **RADR 2213.200 (2:2:0), Radiation Biology and Protection**

SEMESTER: **Spring 2014**

CLASS TIMES: **TR, 11:00 – 11:50**

INSTRUCTOR: **Stacy Randel**

OFFICE: **RC 512B**

OFFICE HOURS: **MTWR: 01:00 – 03:00; By appointment**

OFFICE PHONE: **806-716-4628**

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Facebook: The radiologic technology program has a Facebook page at [www.facebook.com/spradiologictechnologyprogram](http://www.facebook.com/spradiologictechnologyprogram). In addition to the South Plains college websites, this Facebook page will be used to keep students up-to-date on program activities, weather delays, South Plains college announcements and will help with program recruitment. "Liking" the radiologic technology program's Facebook page is not mandatory, nor is a personal Facebook accounts in order to access this page.

BlackBoard: Blackboard is an e-education platform designed to enable educational innovations everywhere by connecting people and technology. This education tool will be used in this course throughout the semester.

*"South Plains College improves each student's life."*

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## GENERAL COURSE INFORMATION

### COURSE DESCRIPTION

This course focuses on the effects of radiation exposure on biological systems. It includes typical medical exposure levels, methods for measuring and monitoring radiation and methods for protecting personnel and patients from excessive exposure.

### PURPOSE

This course will provide the necessary information that will allow the student to assume the responsibilities of radiation protection for patients and personnel, including him or herself.

### STUDENT LEARNING OUTCOMES

The student will be able to:

1. Identify the fundamentals of radiation protection and relevant radiobiology.
2. Apply principles of radiation protection in a medical imaging facility.

### COURSE OBJECTIVES

The student will be able to:

1. Apply the principles of human biology to radiation protection.
2. Apply the principles of radiobiology to radiation protection.
3. Apply the principles of early and late radiation effects to radiation protection.

4. Apply the principles of health physics to radiation protection.
5. Apply the radiation protection features of radiographic and fluorographic equipment.
6. Apply the principles of radiation protection to reduce patient and occupational radiation dose.

## EVALUATION METHODS

The course grade will be determined by a combination major exams and a comprehensive final exam. The following guidelines will be followed regarding exams:

- The student is expected to complete a major exam at the scheduled time. **Make-up major exams will not be given.**
- If one major exam is missed for any reason, the percentage value of that exam is added to the weight of the final exam grade. Any additional missed major exam will result in a zero being recorded for the missed exam.
- A student arriving late for a major exam will not be allowed to take the exam if any student has completed the exam and left the classroom.
- All major exams must be completed within the designated class time.
- Major exams will be returned to the student to be corrected in class. One-half credit will be awarded for each successful correction and added to the original grade.
- A comprehensive final exam will be given during the time designated by South Plains College. **This exam will NOT be corrected for additional points.**

## ACADEMIC INTEGRITY

It is the aim of the faculty of South Plains College to foster a spirit of complete honesty and a high standard of integrity. The attempt of any student to present as his or her own any work which he or she has not honestly performed is regarded by the faculty and administration as a most serious offense and renders the offender liable to serious consequences, possibly suspension.

**Cheating** - Dishonesty of any kind on examinations or on written assignments, illegal possession of examinations, the use of unauthorized notes during an examination, obtaining information during an examination from the textbook or from the examination paper of another student, assisting others to cheat, alteration of grade records, illegal entry or unauthorized presence in the office are examples of cheating. Complete honesty is required of the student in the presentation of any and all phases of coursework. This applies to quizzes of whatever length, as well as final examinations, to daily reports and to term papers.

**Plagiarism** - Offering the work of another as one's own, without proper acknowledgment, is plagiarism; therefore, any student who fails to give credit for quotations or essentially identical expression of material taken from books, encyclopedias, magazines and other reference works, or from themes, reports or other writings of a fellow student, is guilty of plagiarism.

## SCANS and FOUNDATION SKILLS

Scans and foundation skills are identified for specific course objectives. A complete list explaining these skills is attached to the back of the syllabus for your information.

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## SPECIFIC COURSE INFORMATION

### TEXT AND MATERIALS

Bushong, Stewart C. Radiologic Science for Technologists. 9<sup>th</sup> Edition. 2008. Elsevier/Mosby.

## ATTENDANCE POLICY

Class attendance is mandatory. Policies regarding absences coincide with those established for South Plains College as outlined in the SPC General Catalog.

It is important that the student take class attendance very serious, in order to make it possible to complete the course objectives. It is extremely important that students arrive for class on time. Tardiness disrupts the instructor and the other students. **Students that chronically arrive late for class will be counseled and if necessary dropped from the class, regardless of grade point average.**

## CLASS PREPARATION POLICY

The student is responsible for being prepared for class, which means reading the assigned chapters and/or pages from the textbook prior to class. In some instances, information from the reading assignments not covered during class may be included on an exam.

## GRADING POLICY

Grades in this course will be determined using the following criteria:

Assessment Tool	Assessment Criteria	Percentage Score	Grade
<b>MAJOR EXAMS/ CLASS PROJECT 50%</b>	✓ Exceptional unit content knowledge & understanding	91 – 100	A
	✓ Good unit content knowledge & understanding	83 – 90	B
	✓ Average unit content knowledge & understanding	75 – 82	C
	✓ Unacceptable unit content knowledge & understanding	0 – 74	F
<b>FINAL EXAM/CLASS PROJECT Final 50%</b>	✓ Exceptional course content knowledge & understanding	91 – 100	A
	✓ Good course content knowledge & understanding	83 – 90	B
	✓ Average course content knowledge & understanding	75 – 82	C
	✓ Unacceptable unit content knowledge & understanding	0 – 74	F

### Class Weights:

Class Project-Topic submission/Outline/Reference/Final Paper- 20%

Major Exams- 25%

Class Project Final – 20%

Exam Final – 35%

<b>Course Grade:</b> A	91 – 100
B	83 – 90
C	75 – 82
F	0 – 74

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## CLASS ASSIGNMENTS

All assignments will be submitted using the following guidelines

Times New Roman (10 or 12 point for bulk of text)  
1" margins on all sides  
Double spaced  
STANDARD SPC COVER SHEET

### Class Project – 20%

Each student will prepare a class project that will incorporate the following:

- Submission of a topic including two references in APA format for approval.
- Outline of the Final Paper, including references in APA format, which will support each header section of the outline.
- Complete a reference page in APA format.
- Final paper – 3 pages of the body to include header sections to coincide with outline topics. Citing references will be included in the body of the paper. Title page and Reference pages are not included in the required 3 pages.

Examples of an outline, cover page, reference page, how to cite, and a final paper are included under the modules tab on Black Board.

### Class Project Final – 20%

Each student will construct a presentation to be displayed involving the topic they have chosen for their class project. The display will be presented on a corrugated – three panel display board (Science fair board). The presentation must represent the topic chosen and correlate to the Final paper.

### Major Exams – 25%

Five major exams will be given throughout the semester following each module presented. Exams will be multiple choice and done electronically in the computer lab

### Exam Final – 35%

A comprehensive final exam will be given at the end of the semester. Two hours will be allotted for an exam of approximately 100 multiple choice questions and will be done on paper in the classroom.

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## COMMUNICATION POLICY

Electronic communication between instructor and students in this course will utilize the South Plains College “My SPC” and email systems. Instructor will not initiate communication using private email accounts. Students are encouraged to check SPC email on a regular basis.

## STUDENT CONDUCT

Students in this class are expected to abide by the standards of student conduct as defined in the SPC Student Guide.

## CELL PHONES

Cell phones are to be turned OFF during scheduled class periods, unless prior approval has been given from the instructor. This includes text messaging. Cell phones are to be used outside the classroom only.

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## ACCOMMODATIONS

### DIVERSITY STATEMENT

In this class, the teacher will establish and support an environment that values and nurtures individual and group differences and encourages engagement and interaction. Understanding and respecting multiple experiences and perspectives will serve to challenge and stimulate all of us to learn about others, about the larger world and about ourselves. By promoting diversity and intellectual exchange, we will not only mirror society as it is, but also model society as it should and can be.

### DISABILITIES STATEMENT

Students with disabilities, including but not limited to physical, psychiatric, or learning disabilities, who wish to request accommodations in this class should notify the Special Services Office early in the semester so that the appropriate arrangements may be made. In accordance with federal law, a student requesting accommodations must provide acceptable documentation of his/her disability to the Coordinator of Special Services. For more information, call or visit the Special Services Office in rooms 809 and 811, Reese Center Building 8, (806) 885-3048 ext. 4654.

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## COURSE OUTLINE

### Units of Measure and Radiation/Matter Interactions

The student will be able to:

1. Identify and define the units of measure used in radiologic technology and radiobiology.
2. Identify, describe and differentiate between the electromagnetic and particulate radiations applicable to radiobiology.
3. Identify, describe and differentiate between the four factors affecting the interactions between matter and radiation.
4. Identify, describe and differentiate between the interactions between electromagnetic radiation and tissue applicable to radiobiology.
5. Identify, describe and differentiate between the interactions between particulate radiation and tissue applicable to radiobiology.

Text Assignment: Bushong, Ch. 2, pp. 34 – 35; Ch. 3, p. 52 & 53; Ch. 10

### Fundamental Principles of Radiobiology

The student will be able to:

1. Explain ALARA.
2. Identify the sources of radiation that contribute to the total average effective dose for the U.S.A. inhabitants.
3. Define *radiobiology* and explain its relevance to radiation protection. (F12)
4. Identify the importance of the *Law of Bergonie and Tribondeau* in radiobiology. (F10;C5)
5. Explain the important parts of the *Law of Bergonie and Tribondeau*. (C7)
6. Differentiate between *radioresistant* and *radiosensitive*.
7. Identify and rank the radiosensitivity of various human cell types, tissues and organs.
8. Identify the factors that affect a tissue's radiosensitivity.
9. Explain how *linear energy transfer (LET)* affects the amount of biological damage produced in living matter by ionizing radiation. (F10:C15)

10. Identify the relative LET values for the major ionizing radiations.
11. Describe the interrelationship between LET and *relative biological effectiveness (RBE)*. (F12)
12. Calculate RBE values. (F3)
13. Differentiate between radiation dose *fractionation* and *protraction*. (F10)
14. Identify the biologic factors affecting radiosensitivity. (C5)
15. Define the term: *radiation dose-response relationship*.
16. Explain the applications of radiation dose-response relationships in radiology. (F12;C15)
17. Differentiate between *linear* and *nonlinear* radiation dose-response relationships. (F10)
18. Differentiate between *threshold* and *non-threshold* radiation dose-response relationships. (F10)

Text Assignment: Bushong, Ch. 33

### Molecular and Cellular Radiobiology

The student will be able to:

1. Identify the principal effects of *in vitro* irradiation of macromolecules.
2. Identify the radiation effects on DNA.
3. Identify the chemical reactions involved in the *radiolysis* of water.
4. Explain the significance of radiolysis of water to radiation biology. (F12)
5. Explain the difference between *direct* and *indirect* effects of ionizing radiation. (F10,12:C15)
6. Explain the *target theory*. (F10;C15)
7. Discuss the kinetics of *human cell survival* after irradiation.
8. Identify the characteristics of the *Single-Target, Single-Hit Model* of cell survival.
9. Identify the characteristics of the *Multi-Target, Single-Hit Model* of cell survival.
10. Identify the effects of cell cycle, LET, RBE and OER on the radiation response of the human cell.

Text Assignment: Bushong, Ch. 34

### Early Effects of Radiation

The student will be able to:

1. Identify the principal *early effects* of radiation exposure on humans, and the approximate minimum radiation dose necessary to produce them.
2. Identify the sequence of events of the *acute radiation syndrome*.
3. Identify the minimum dose, clinical signs and symptoms of the *prodromal syndrome*.
4. Identify the dose range, clinical signs and symptoms of the *latent period*.
5. Identify the dose range, clinical signs and symptoms of the *hematologic syndrome*.
6. Identify the dose range, clinical signs and symptoms of the *gastrointestinal syndrome*.
7. Identify the dose range, clinical signs and symptoms of the *central nervous system syndrome*.
8. Identify the *LD 50/30* for human adults and explain its significance.
9. Explain the relationship between *whole body radiation dose* and *mean survival time*. (F12)
10. Identify the factors that affect the immediate response of local tissue to radiation exposure.
11. Identify the manner in which the skin will immediately respond to radiation exposure.
12. Identify the manner in which the gonads will immediately respond to radiation exposure.
13. Identify the principal response of the hemopoietic system to radiation exposure.
14. Identify the relative radiosensitivity of various types of blood cell.
15. Identify the possible cytogenetic effects of radiation exposure.

Text Assignment: Bushong, Ch. 35

## Late Effects of Radiation

The student will be able to:

1. Define *late effects* in relation to radiation exposure.
2. Identify the types of local tissue damage from irradiation.
3. Identify the three methods of stating *cancer risk*. (C7)
4. Differentiate between the three methods of stating *cancer risk*. (C7)
5. Identify the risks for various types of radiation induced cancer.
6. Identify the risks of low-dose radiation to fertility and pregnancy.
7. Explain the concept of *doubling dose*.
8. Define *genetically significant dose*.
9. Identify the genetically significant dose for humans.

Text Assignment: Bushong, Ch. 36

## Health Physics

The student will be able to:

1. Explain the *risk vs. benefit* concept regarding radiation exposure.
2. Explain the *ALARA* concept. (F12;C15,16)
3. Identify the *basic principles* of radiation protection.
4. Describe the relationship between time and radiation exposure. (F12;C15)
5. Describe how distance can be used to reduce occupational exposure. (F12;C15)
6. Calculate radiation intensities using the *Inverse Square Law*. (F3;C5)
7. Identify the recommended *dose equivalent limits*. (F1;C5)
8. Calculate the *whole body dose equivalent limit* for a radiographer. (F3,4;C5)
9. Identify the radiobiological considerations of pregnancy and radiation exposure.
10. Identify the effects of irradiation in utero to the embryo/fetus.
11. Identify the recommended management procedures for pregnant radiation workers and for the pregnant patient. (F9,12;C5,11,18,19)

Text Assignment: Bushong, Ch. 37

## Designing for Radiation Protection

The student will be able to:

1. Identify and explain various *radiographic equipment* design features that reduce radiation exposure. (F12;C15,18,19)
2. Identify and explain various functions of *radiographic equipment* that must be monitored to reduce radiation exposure resulting from repeat radiographs. (F12;C15,18,19)
3. Identify and explain various *fluorographic equipment* design features that reduce radiation exposure. (F12;C15,18,19)
4. Identify and explain various functions of *fluorographic equipment* that must be monitored to reduce radiation exposure. (F12;C15,18,19)
5. Describe the construction of *protective structural shielding*. (C15)
6. Identify the factors which govern the selection of appropriate construction materials. (C15)
7. Identify the factors affecting protective barrier *thickness*. (C12)

8. Explain the construction and principles of *gas-filled radiation survey instruments*. (F10;C15)
9. Identify the *five regions of a characteristic curve* of a gas-filled detector and their characteristics.
10. Identify the uses of a gas-filled detector in radiology. (C15,18,19)
11. Explain the scintillation process of a *scintillation detection device*. (F10;C15)
12. Identify different types of scintillation phosphors.
13. Identify the basic components of a *scintillation detector* and their function. (C15)
14. Identify the uses of a scintillation detector in radiology. (C15,18,19)

Text Assignment: Bushong, Ch. 38

### **Patient Radiation Dose Management**

The student will be able to:

1. Identify three ways that patient dose can be reported. (C5,7)
2. Discuss ALARA principles applied to the management of patient radiation dose.
3. Identify the factors affecting patient radiation dose. (C18,19)
4. Identify the radiosensitivity characteristics of the stages of pregnancy.
5. Identify the recommended management procedures for the pregnant patient.
6. Identify ways to reduce patient dose. (F9,10,12;C11,15,18,19)
7. Identify the various types of gonadal shields available and their appropriate use during radiographic procedures. (F9,10,12;C11,15,18,19)

Text Assignment: Bushong, Ch. 39

### **Occupational Radiation Dose Management**

The student will be able to:

1. Identify the *radiation units of measure* and their use in occupational radiation exposure.
2. Identify the three ways of *reporting patient dose* from diagnostic x-rays.
3. Identify the purpose of wearing a *personnel monitoring device*. (F12)
4. Explain the function of a personnel monitoring device. (C15)
5. Identify the appropriate location(s) for wearing a personnel monitoring device during radiography and fluorography. (C18,19)
6. List the characteristics of a personnel monitoring device.
7. Identify and describe the components, advantages and disadvantages for the following types of dosimeters: *film, pocket ionization chamber, thermoluminescent* and *optically stimulated luminescent*. (F10;C15,18,19)
8. Identify the significant data available on a *personnel monitoring report*. (F1, 12;C5)
9. Identify and describe the use of radiation shields in diagnostic radiography. (C3,18,19)
10. Identify and explain methods of reducing occupational exposure during fluoroscopy, special procedures and mobile radiography. (C15,18,19)
11. Identify the pros and cons of radiographers holding patients for radiographic procedures and alternatives for holding patients for radiographic procedures.

Text Assignment: Bushong, Ch. 40



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## FOUNDATION SKILLS

### **BASIC SKILLS—Reads, Writes, Performs Arithmetic and Mathematical Operations, Listens and Speaks**

F-1 Reading—locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules.

F-2 Writing—communicates thoughts, ideas, information and messages in writing and creates documents such as letters, directions, manuals, reports, graphs, and flow charts.

F-3 Arithmetic—performs basic computations; uses basic numerical concepts such as whole numbers, etc.

F-4 Mathematics—approaches practical problems by choosing appropriately from a variety of mathematical techniques.

F-5 Listening—receives, attends to, interprets, and responds to verbal messages and other cues.

F-6 Speaking—organizes ideas and communicates orally.

### **THINKING SKILLS—Thinks Creatively, Makes Decisions, Solves Problems, Visualizes and Knows How to Learn and Reason**

F-7 Creative Thinking—generates new ideas.

F-8 Decision-Making—specifies goals and constraints, generates alternatives, considers risks, evaluates and chooses best alternative.

F-9 Problem Solving—recognizes problems, devises and implements plan of action.

F-10 Seeing Things in the Mind's Eye—organizes and processes symbols, pictures, graphs, objects, and other information.

F-11 Knowing How to Learn—uses efficient learning techniques to acquire and apply new knowledge and skills.

F-12 Reasoning—discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem.

### **PERSONAL QUALITIES—Displays Responsibility, Self-Esteem, Sociability, Self-Management, Integrity and Honesty**

F-13 Responsibility—exerts a high level of effort and perseveres towards goal attainment.

F-14 Self-Esteem—believes in own self-worth and maintains a positive view of self.

F-15 Sociability—demonstrates understanding, friendliness, adaptability, empathy and politeness in group settings.

F-16 Self-Management—assesses self accurately, sets personal goals, monitors progress and exhibits self-control.

F-17 Integrity/Honesty—chooses ethical courses of action.

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## SCANS COMPETENCIES

C-1 **TIME** - Selects goal - relevant activities, ranks them, allocates time, prepares and follows schedules.

C-2 **MONEY** - Uses or prepares budgets, makes forecasts, keeps records and makes adjustments to meet objectives.

C-3 **MATERIALS AND FACILITIES** - Acquires, stores, allocates, and uses materials or space efficiently.

C-4 **HUMAN RESOURCES** - Assesses skills and distributes work accordingly, evaluates performances and provides feedback.

### **INFORMATION - Acquires and Uses Information**

C-5 Acquires and evaluates information.

C-6 Organizes and maintains information.

C-7 Interprets and communicates information.

C-8 Uses computers to process information.

### **INTERPERSONAL—Works With Others**

C-9 Participates as a member of a team and contributes to group effort.

C-10 Teaches others new skills.

C-11 Serves Clients/Customers—works to satisfy customer’s expectations.

C-12 Exercises Leadership—communicates ideas to justify position, persuades and convinces others, responsibly challenges existing procedures and policies.

C-13 Negotiates—works toward agreements involving exchanges of resources; resolves divergent interests.

C-14 Works With Diversity—works well with men and women from diverse backgrounds.

### **SYSTEMS—Understands Complex Interrelationships**

C-15 Understands Systems—knows how social, organizational, and technological systems work and operates effectively with them.

C-16 Monitors and Corrects Performance—distinguishes trends, predicts impacts on system operations, diagnoses systems performance and corrects malfunctions.

C-17 Improves or Designs Systems—suggests modifications to existing systems and develops new or alternative systems to improve performance.

### **TECHNOLOGY—Works with a Variety of Technologies**

C-18 Selects Technology—chooses procedures, tools, or equipment, including computers and related technologies.

C-19 Applies Technology to Task—understands overall intent and proper procedures for setup and operation of equipment.

C-20 Maintains and Troubleshoots Equipment—prevents, identifies, or solves problems with equipment, including computers and other technologies.

**Radiation Biology and Protection**  
**RADR 2213.200**  
**Fall 2014**

**Test & Assignment Schedule**

<b>Test</b>	<b>Date</b>
<b>Topic Submission Due</b>	01/28/14
<b>Test I</b>	01/28/14
<b>Test II</b>	02/11/14
<b>Outline Due</b>	02/18/14
<b>Test III</b>	03/04/14
<b>Reference Page Due</b>	03/13/14
<b>Test IV</b>	04/01/14
<b>Final Paper Due</b>	04/08/14
<b>Test V</b>	04/22/14
<b>Final Project Due</b>	04/24/14
<b>Final Exam</b>	05/06/14; 10:15 – 12:15

1. **ANY information covered in class and/or reading assignment is a potential question on an exam.**
2. All exams must be completed during the scheduled class time: 50 minutes.
3. Make-up exams will not be given.
4. Students arriving late for an exam and after another student has completed and turned in an exam will not be allowed to take the exam.
5. Students are not allowed to share calculators during an exam.
6. Cell phones may not be used as a calculator.
7. Cell phones must be turned off during an exam. A cell phone that rings during an exam will result in the student's test being taken up.
8. Electronic translators, dictionaries etc cannot be used during an exam.
9. Textbooks, notes and/or handouts cannot be shared during the test corrections.
10. Test corrections must be completed during the scheduled class time: 50 minutes.
11. Cell phones must be turned off during test corrections. A cell phone that rings during the corrections will result in the student's test being taken up.

**RADR 2213.200: RADIATION BIOLOGY AND PROTECTION**  
**Spring 2014**

TUESDAY	THURSDAY	TUESDAY	THURSDAY	TUESDAY	THURSDAY
1/14  Radiation units; EM & Particulate; Photon interact	1/16 Ch. 33  Radiosensitivity; DNA & Human Biology	1/21 Ch. 33  Radiobiology – LET – RBE – P & F	1/23 Ch. 33 Stacy Gone Radiobiology – Factors – D-R Curves	1/28  TEST I Topic Submission Due	1/39  TEST I Corrections
2/4 Ch. 34  Molecular RB – DNA – Radiolysis of H2O	2/6 Ch. 34  Molecular RB – Target/Hit Models – Cell survival – Early effects	2/11  TEST 2	2/13  TEST 2 Corrections	2/18 Ch. 35  Early Effects  Outline Due	2/20 Ch. 35  Early Effects; Late Effects
2/25 Ch. 36  Late Effects	2/27 Ch. 37  Health Physics; Dose Limits; X-rays & Pregnancy	3/4  TEST 3	3/6  TEST 3 Corrections	3/11  Protection: Equipment features	3/13  Protection: – Barriers  – Reference page due
3/18 Ch. 38  SPRING BREAK –	3/20 Ch. 38  SPRING BREAK –	3/25 Ch. 38  Protection: – Barriers	3/27 Ch. 38  Radiation detectors	4/1  TEST 4	4/3  TEST 4 Corrections
4/8 Ch. 39  Patient dose – Management – Nomograms	4/10 Ch. 39  Patient dose – Management	4/15 Ch. 40  Occupational – Dose management	4/17 Ch. 40  Dosimeters – TDL – Film badge – Thermo, etc	4/22  TEST 5	4/24  TEST 5 Corrections Final Project Due
4/29  ARRT Info	5/1  REVIEW	5/6  FINAL EXAM (10:15 – 12:15)	5/9		