

*South Plains College-Reese Campus*  
**Course Syllabus**

**COURSE:** RADR 1213.200 (2:2:0), Principles of Radiographic Imaging I  
**SEMESTER:** Fall 2015  
**CLASS TIMES:** MW, 10:30-11:20  
**INSTRUCTOR:** Stacy Randel, MSRS  
**OFFICE:** RC 512H  
**OFFICE HOURS:** M-R, 01:00 – 03:00; By appointment  
**OFFICE PHONE:** 806-716-4928  
**E-MAIL:** [srandel@southplainscollege.edu](mailto:srandel@southplainscollege.edu)

**Facebook:** The radiologic technology program has a Facebook page at [www.facebook.com/spcradiologictechnologyprogram](http://www.facebook.com/spcradiologictechnologyprogram). 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 are 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 radiographic image quality and the effects of exposure variables.

**PURPOSE**

This course will provide students with the technical information required to produce a diagnostic radiographic image and prepare the student for a meaningful clinical experience.

**STUDENT LEARNING OUTCOMES**

The student will:

1. Control radiographic exposure and image production using the fundamental technical factors of mAs, kVp and SID.
2. Select appropriate technical factors and accessory equipment to enhance the radiographic exposure and image production.
3. Identify the characteristics of a diagnostic radiograph.
4. Assess radiographic images for optical density, contrast and recorded detail.

**COURSE OBJECTIVES**

The student will:

1. Adhere to strict radiation protection standards using time, distance and shielding for patient, visitor, staff and himself/herself.
2. Use the appropriate radiographic unit of measure when discussing radiation exposure and radiation dose.

3. Select and control radiographic exposure technique factors that will produce a beam of radiation capable of producing a diagnostic radiographic image.
4. Identify characteristics of electromagnetic radiation and explain their relationship to each other.
5. Differentiate between electromagnetic radiation and particulate radiation.
6. Describe the processes of x-radiation and heat production in the x-ray tube.
7. Identify the characteristics of a primary x-ray beam.
  8. Describe the possible interactions between x-radiation and matter.
  9. Select and control radiographic exposure technique factors that will produce a diagnostic radiographic image.
10. Assess a radiographic image for diagnostic optical density, contrast and recorded detail.
11. Analyze and adjust appropriate factors to obtain a diagnostic radiograph.

## 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. 10<sup>th</sup> Edition. 2013. 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 extremely important that students arrive for class **on time**. **Tardiness** disrupts the instructor and the other students. Students who chronically arrive late will be counseled and if necessary, dropped from the class regardless of their grade point average. The student should be prepared for class at the scheduled class start time. **Students with perfect attendance will be awarded 2 points to their final grade at the end of the semester.**

## CLASSROOM PARTICIPATION

Attending class regularly will provide the student opportunity to supplement their reading assignments and acquire a better understanding of the course material. Class time missed will result in information gaps and will increase course difficulty. It is the student's responsibility to attend class which will enable him or her to take notes, ask questions, and participate in class discussions. Information handouts may be given in certain instances, but the student should not rely on them. The student is encouraged to take adequate notes during class. Recording class is permitted.

## ASSIGNMENT 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.

## REVIEW

Time is limited and the amount of information that must be covered during class is significant. In most cases, there will not be class time available for review prior to a test. If a student needs assistance with reviewing information for a test, the student is encouraged to make an appointment with the instructor.

## COMMUNICATION POLICY

Electronic communication between instructor and students in this course will utilize the South Plains College email system. Any handouts or study guides will be distributed using the Blackboard Learning Management System. The instructor will not initiate communication using private email accounts.

## EVALUATION METHODS

The course grade will be determined by a combination of 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 exams will be scheduled with the instructor.**
- 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.
- A comprehensive final exam will be given during the time designated by South Plains College.
- It is the responsibility of the student to bring an appropriate calculator to class. **Students will not be allowed to share calculators during any assignment or exam.**

## GRADING RUBRIC

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

Assessment Tool	Assessment Criteria	Percentage Score	Grade
<b>MAJOR EXAMS 55%</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
	✓ Insufficient unit content knowledge & understanding	0 – 74	F
<b>FINAL EXAM 45%</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
	✓ Insufficient unit content knowledge & understanding	0 – 74	F

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

**A grade average of C (75) must be maintained in all RAD TECH classes.** Failure to do so will result in the student being dropped from the Program.

## STUDENT CONDUCT

Students in this class are expected to abide by the standards of student conduct as defined in the SPC Student Guide pages 11-14.

## CELL PHONES

Cell phone use, including text messaging, is not allowed during class. Cell phones are to be turned **OFF** during scheduled class periods, unless prior approval has been given from the instructor. 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

#### ADA 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 Disability 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 Disability Services Office. For more information, call or visit the Disability Services Office through the Guidance and Counseling Centers at Reese Center (Building 8) [716-4606](tel:7164606), or Levelland (Student Services Building) [716-2577](tel:7162577).

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## COURSE OUTLINE

### ESSENTIAL CONCEPTS OF RADIOLOGIC SCIENCE

The student will:

1. Identify major events in the discovery and advancement of x-ray imaging.
2. Identify the characteristics of matter and energy.
3. Identify the types of energy applicable to radiography.
  - Potential
  - Kinetic
  - Electrical
  - Thermal
4. Describe the use of time, distance and shielding for effective radiation protection. (F8, F9; C18, C19)
5. Use the radiologic units of measure.
  - Exposure: Roentgen ( $\text{Gray}_{\text{kerma}}$ )
  - Absorbed dose: RAD ( $\text{Gray}_{\text{tissue}}$ )
  - Dose Equivalent: REM (Seivert)
  - Radioactivity: Curie (Becquerel)
6. Identify the basic particles of an atom: proton, neutron & electron.
7. Define atomic number and atomic mass number.
8. Describe binding energy as it applies to the atom's electron(s). (F10)
9. Identify the types of ionizing radiation.
10. Identify the principle particulate radiations: *alpha* particle, *positron* and *beta* particle.
11. Differentiate between electromagnetic and particulate radiation.

Text Assignment: Bushong, Ch. 1, pp. 1 – 7, 10 – 12, & 22 – 23; Ch. 2, pp. 29 – 37, 41 - 43

## Electromagnetic Energy

The student will:

1. Define *photon*.
2. Identify the properties of electromagnetic (EM) photons, their relationship and how they affect interactions with matter. (F10, F12)
  - Velocity
  - Wavelength
  - Frequency
  - Energy
3. Identify the *speed of light*.
4. Calculate photon wavelength or frequency ( $v = f\lambda$ ). (F4)
5. Identify the content of the *electromagnetic spectrum* and their arrangement pertinent to radiography.
  - Visible light, infrared light, ultraviolet light
  - Radiofrequency
  - Ionizing radiation
6. Differentiate between *x-radiation* and *gamma radiation*. (F12)
7. Explain the *wave-particle duality* of radiation. (F12)
8. Define the *Inverse Square Law*. (F12)
  - $I_1/I_2 = (d_2/d_1)^2$  (F4)
  - Inverse relationship with radiation intensity
9. Calculate radiation intensity using the Inverse Square Law formula. (F4)
10. Explain *ionization*.

Text Assignment: Bushong, Ch. 3

## X-Ray Production and Emission

The student will:

1. Identify the general components and function of permanently installed radiographic equipment. (C15)
  - Operating console
  - Radiographic table & wall unit
  - Radiographic tube stand, x-ray tube and beam restrictor
2. Identify the major components of a diagnostic x-ray tube. (C15)
  - Enclosure
  - Cathode
  - Anode
3. Explain *thermionic emission*, *space charge* and *tube current*. (F10, C15)
4. Explain *heat production* and the factors that affect it. (F10; C15)
5. Explain *characteristic x-ray* production and the factors that affect it. (F10; C15)
6. Explain *bremstrahlung x-ray* production and the factors that affect it. (F10; C15)
7. Identify the x-ray technical factors: milliamperage-seconds (mAs), kilovoltage-peak (kVp), filtration and source-to-image distance (SID) and explain their importance in x-ray production & emission.
8. Describe primary *x-ray beam quantity* and the effects of mAs, kVp, filtration and SID. (F10; C15)
9. Describe primary *x-ray beam quality* and the effects of kVp and filtration. (F10; C15)

10. Identify the information contained in a *continuous x-ray spectrum* and a *discrete x-ray spectrum*.
11. Anticipate how a change in any given technical factor will affect both forms of x-ray production. (F8, F9, F10, F12; C15)

Text Assignment: Bushong, Ch. 6, pp. 105 – 112; Ch. 7

## X-RAY EMISSION

The student will:

1. Define *x-ray beam quantity* and relate it to x-ray intensity. (C15)
2. List and explain the technical factors that affect x-ray beam intensity: mAs, kVp, filtration, SID.
3. Use the *Square Law* to calculate a necessary mAs change when SID is altered. (F4, F12; C15)
  - $mAs_1/mAs_2 = (SID_1/SID_2)^2$
4. Define *x-ray beam quality (energy)* and relate it to x-ray penetration. (F12; C15)
5. List and explain the technical factors that affect x-ray beam quality: kVp, filtration and half-value layer (HVL).
6. Differentiate between the various types of filtration: inherent, added and compensating.

Text Assignment: Bushong, Ch. 8

## X-RAY INTERACTION WITH MATTER

The student will:

1. Explain a *coherent (classical)* EM photon and matter interaction, including production, energy and effects. (F8, F10; C15)
2. Explain a *Compton* EM photon and matter interaction, including production, energy and effects. (F8, F10; C15)
3. Explain a *photoelectric* EM photon and matter interaction, including production, energy and effects. (F8, F10; C15)
4. Explain *pair production* and why it does not occur in diagnostic radiography. (F8, F10; C15)
5. Explain *photodisintegration* and why it does not occur in diagnostic radiography. (F8, F10; C15)
6. Explain why Compton and photoelectric interactions are important in radiologic technology. (F8, F10; C15)
7. Identify the interactions involved in differential absorption. (F10; C15)
8. Explain *differential absorption* in radiographic imaging. (F10)
9. Identify the factors that control and influence differential absorption. (C15)
10. Explain radiographic exponential attenuation of x-rays by matter. (F10)
11. Identify the components of the *remnant (exit) x-ray beam*.
12. Define *radiographic exposure*.
13. Describe the process of radiographic image formation. (F8, F10; C15)
  - Differential absorption
  - Beam attenuation
  - Scattering
  - Transmission

Text Assignment: Bushong, Ch. 9

## RADIOGRAPHIC IMAGE FORMATION

The student will:

1. Identify and define the properties that result in **visibility of detail**. (F10)
  - Optical density
  - Contrast
2. Identify and define the properties of short scales of high contrast. (F10)
3. Identify and define the properties of long scales of low contrast. (F10)
4. Differentiate between **radiographic contrast** and **subject contrast**. (C15)
5. Identify the effects of the primary radiographic technical factors on **visibility of detail**. (F12)
  - kVp
  - mAs = mA x exposure time
  - SID
  - Image receptor properties
6. Identify the effect of **scatter radiation** on the radiographic image. (F8, F9, F10)
7. Identify and define the properties that result in diagnostic **recorded detail**. (F10)
8. Identify the radiographic geometric properties that affect recorded detail. (F10)
  - Focal spot size
  - SID
  - OID
9. Identify the key factors in producing the most diagnostic recorded detail.
10. Define radiographic distortion. (F10)
11. Differentiate between **radiographic size distortion** and **radiographic shape distortion**. (C15)
12. Identify and explain the effects of the components of **radiographic exposure technique**.
  - **Primary technical factors:** mAs, kVp
  - **Secondary technical factors:** focal spot size, SID, OID, beam restriction, filters, grids, x-ray generators, central ray (CR) alignment.

Text Assignment: Study Guide Handout

## SCREEN-FILM RADIOGRAPHY

The student will:

1. Identify and describe the components of radiographic film.
2. Describe the production of silver halide crystals.
3. Describe **latent image** formation.
4. Identify and describe the characteristics that are considered when selecting a screen-film combination: **contrast**, **speed**, **spectral matching**, **anti-crossover/anti-halation dyes** and **safe light requirements**.
5. Identify and explain the factors that determine film **speed** and **contrast**.
6. Differentiate between single and double emulsion x-ray film. (C18)
7. State the **Reciprocity Law**.
8. Relate the Reciprocity Law to radiographic film and exposure.
9. Identify and differentiate between the types of film used in imaging.
10. Identify the fundamentals of proper film storage and handling.
11. Explain the purpose of radiographic **intensifying screens**. (C19)
12. Identify and describe the function of each layer of an **intensifying screen**.
13. Differentiate between **luminescence**, **fluorescence** and **phosphorescence**.
14. Identify the **phosphors** used in radiographic intensifying screens.
15. Compare the **conversion efficiency** of calcium tungstate and rare earth intensifying phosphors. (C15)
16. Identify the effect of **phosphor crystal size**, **layer thickness** and **concentration** on **screen speed** and **recorded detail**.



17. Explain the concept of *light diffusion* with screen phosphors.
18. Describe the construction of a typical radiographic *cassette*.
19. Identify the effect of *film-screen contact* on recorded detail.
20. Describe the QC test for evaluating *film-screen contact*. (C20)
21. Identify the advantages of *rare earth* intensifying screens over conventional *calcium tungstate* screens.
22. Identify the *kV range* that will produce maximum efficiency with calcium tungstate and rare earth screens. (C18)
23. Define *relative speed value*.
24. Employ *relative speed value* to adjust technical factors to maintain correct exposure and image quality. (F3)
25. Describe the proper *cleaning and care* of radiographic cassettes and screens.
26. Identify and explain the basic components of *automatic processing*.
27. Identify the chemical elements in the *developer* solution.
28. Identify the function of each of the chemical elements in the *developer* solution. (C15)
29. Explain the importance of proper *development* of the radiographic image.
30. Identify the chemical elements in the *fixer* solution.
31. Identify the function of each of the chemical elements in the *fixer* solution. (C15)
32. Explain the importance of proper *fixing* of the radiographic image.
33. Identify the subsystems of the *transport system* of an automatic processor.
34. Explain the purpose of the *circulation/filtration system* of an automatic processor. (C15)
35. Explain the importance of maintaining accurate processing *temperatures*. (C15)
36. Identify the *recommended temperature* of the chemical system of an automatic processor. (C15)
37. Explain the purpose of the *replenishment system*. (C15)
38. Identify the method for establishing *replenishment rates*.
39. Identify the established *replenishment rates* for developer and fixer.
40. Identify the effects of a change in *replenishment rates* for developer and fixer.
41. Identify the components of the *dryer system* of an automatic processor.
42. Identify *three alternate methods* of automatic processing and their value in radiographic imaging.

Text Assignment: Bushong, Ch. 12

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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.

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