

COURSE SYLLABUS

Department: Radiologic Technology
Course Title: Radiographic Imaging Equipment
Section Name: RADR 2309
Start Date: 08/27/2012
End Date: 12/07/2012
Modality: FACE-TO-FACE
Credits: 3

Instructor Information

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Course Description

Equipment and physics of x-ray production, includes basic x-ray circuits. Also examines the relationship of conventional and digital components to the imaging process. The student will describe the equipment and physics of x-ray production; describe basic x-ray circuits; and relate equipment components to the imaging process. Includes radiographic/fluoroscopic equipment and computed and digital radiography.

Prerequisites/Corequisites

Prerequisite: RADR 1311. Corequisites: RADR 1266, RADR 1303, and RADR 2301.

Institutional Course Objectives

1, 2, 3

Course Objectives

LEARNING OUTCOMES:

The student will differentiate between conventional and digital equipment; explain the physics of x-ray production; describe x-ray circuits; and relate conventional and digital equipment components to the imaging process.

COMPUTER PROGRAMS AVAILABLE IN CT 216 (COMPUTER LAB)

Challenge, Radiographic Physics, Coretec, 2009
Radiographic Imaging, Mosby, 1998 MCD
Physics Challenge, Coretec, 2009 MCD

COURSE COMPETENCIES

1XRA.24.00 EVALUATE THE PATIENTS PHYSICAL NEEDS

1XRA.24.04 Convert a Fahrenheit measurement to a Celsius.

1XRA.36.00 DESCRIBE /DISCUSS THE CHEMICAL COMPOSITION OF THE BODY

1XRA.36.01 Define the terms atom, ion, atomic number and atomic weight.

1XRA.36.02 Describe the nature and different types of chemical bonds.

1XRA.69.00 EXPLAIN/DEMONSTRATE/USE EXPOSURE SYSTEMS

1XRA.69.03 Distinguish among various types of exposure systems.

2XRA.01.00 DISCUSS/OPERATE RADIOGRAPHIC EQUIPMENT

2XRA.01.01 Discuss permanent installation of radiographic equipment in terms of purpose, components, types, and application.

2XRA.01.03 Discuss mobile units in terms of purpose, components, types and applications.

2XRA.09.00 IDENTIFY/EMPLOY THE UNITS OF MEASUREMENT

2XRA.09.01 State the fundamental units of the English, Metric and SI systems.

2XRA.09.02 Define derived units of the English, Metric and SI systems.

2XRA.09.03 Given problems, convert units from one system to the other.

2XRA.10.00 DISCUSS/WORK WITH THE GENERAL PRINCIPLES OF RADIOGRAPHIC PHYSICS

2XRA.10.01 Define and describe the general principles that relate to inertia, work, energy and momentum.

2XRA.10.02 Define derived units of the English, Metric and SI system.

2XRA.10.03 Given problems, convert units from one system to the other.

2XRA.11.00 KNOW THE STRUCTURE OF MATTER

2XRA.11.01 Define mixture.

2XRA.11.02 Describe the characteristics and give an example of a mixture.

2XRA.11.03 Define substance and give an example of a substance.

2XRA.11.04 Define element.

2XRA.11.05 Describe the characteristics of an element using the periodic table.

2XRA.11.06 Define compound and give an example of a compound.

2XRA.11.07 Describe the characteristics of a molecule.

2XRA.12.00 DISCUSS/DIAGRAM THE STRUCTURE OF THE ATOM

2XRA.12.01 Describe Bohr's theory of atomic structure.

2XRA.12.02 Discuss the characteristics and function of a proton, neutron, and electron.

2XRA.12.03 Discuss the energy levels of the atom.

2XRA.12.04 Define the terms relating to atomic nomenclature.

2XRA.12.05 Compare covalent bonding to ionic bonding.

2XRA.12.06 Explain the process of ionization.

2XRA.13.00 DESCRIBE THE NATURE OF RADIATION AND MATHEMATICALLY DEMONSTRATE THE RELATIONSHIPS BETWEEN ENERGY, FREQUENCY AND WAVELENGTH OF X- RADIATION

2XRA.13.01 Describe the nature of light.

2XRA.13.02 Define and describe wavelength and frequency and how they are related to velocity.

2XRA.13.03 Describe the electromagnetic spectrum.

2XRA.13.04 Explain the relationship of energy and frequency to Planck's Constant.

2XRA.14.00 DISCUSS/DEMONSTRATE ELECTROSTATICS

2XRA.14.01 Define electrical charge and describe its source.

2XRA.14.02 Define electrical field and describe its source.

2XRA.14.03 Explain methods of electrification.

2XRA.14.04 Explain the Laws of Electrostatics and their application.

2XRA.15.00 DISCUSS ELECTRODYNAMICS AND DEMONSTRATE UNDERSTANDING OF PRINCIPLES MATHEMATICALLY

- 2XRA.15.01 Define potential difference, current, resistance, circuit, and electric power.
- 2XRA.15.02 Describe the characteristics of direct and alternating currents.
- 2XRA.15.03 Given a schematic diagram of a resistance circuit, label the parts.
- 2XRA.15.04 Identify and apply Ohm's Law to resolve direct current problems.
- 2XRA.15.05 Identify and apply power formulas to determine power consumed.
- 2XRA.15.06 Describe electrical measuring devices.
- 2XRA.15.07 Given a schematic diagram of a circuit, label the electrical measuring devices.
- 2XRA.15.08 Describe electrical protective devices.

2XRA.16.00 DISCUSS/DEMONSTRATE MAGNETISM

- 2XRA.16.01 Discuss the properties of magnetism.
- 2XRA.16.02 Discuss the laws of magnetism.
- 2XRA.16.03 Discuss the domain theory.
- 2XRA.16.04 Relate the electronic spin of an element to its potential magnetic properties.
- 2XRA.16.05 Explain the principle of magnetic induction.
- 2XRA.16.06 Given the list of materials, classify according to magnetic properties.

2XRA.17.00 DESCRIBE ELECTROMAGNETISM AND EXPLAIN ITS RELEVANCE IN RADIOGRAPHY

- 2XRA.17.01 Explain the interaction between electric and magnetic fields.
- 2XRA.17.02 Discuss types of electromagnetic induction.
- 2XRA.17.03 Describe types and functions of generators, motors, transformers and rectification systems.
- 2XRA.17.04 Compare single phase, three phase, high frequency and falling load generators in terms of radiation production and efficiency.

2XRA.18.00 DISCUSS RECTIFICATION AND ITS ROLE IN PRODUCTION OF X-RAYS

- 2XRA.18.01 Define rectification.
- 2XRA.18.02 Explain the purpose of rectification.
- 2XRA.18.03 Compare solid state and vacuum tube rectification in terms of function and advantages/disadvantages.

2XRA.19.00 DISCUSS/OPERATE DIAGNOSTIC X-RAY TUBES

- 2XRA.19.01 Discuss the characteristics of a rotating anode in terms of description and function.
- 2XRA.19.02 Discuss the characteristics of a cathode in terms of description and function.
- 2XRA.19.03 Discuss the construction characteristics of tube housing in terms of description and function.
- 2XRA.19.04 Discuss the characteristics of cables in terms of description and function.
- 2XRA.19.05 Given a diagram of an x-ray tube, label the parts.
- 2XRA.19.06 Given tube rating charts, determine maximum allowable exposure factors for various radiographic procedures.
- 2XRA.19.07 Given simulated exposure factors, use an anode cooling chart to determine the anode cooling rate.
- 2XRA.19.08 Given simulated exposure factors and a cooling chart, determine heat units and cooling characteristics of x-ray tube housing.
- 2XRA.19.09 Describe methods to extend tube life.

2XRA.20.00 DESCRIBE/DIAGRAM X-RAY CIRCUITS, IDENTIFYING COMPONENTS AND THEIR FUNCTIONS AND PURPOSES

- 2XRA.20.01 Describe the components of a primary x-ray circuit and explain the function of each component.
- 2XRA.20.02 Describe the components of a secondary x-ray circuit and explain the function of each component.
- 2XRA.20.03 Describe the components of an x-ray filament circuit and explain the function of each component.
- 2XRA.20.04 Given a simple diagram of a complete x-ray circuit, label the parts.
- 2XRA.20.05 Discuss the components and application of automatic exposure devices.

2XRA.21.00 EXPLAIN/DIAGRAMMATICALLY REPRESENT THE PRODUCTION AND CHARACTERISTICS OF RADIATION

2XRA.21.01 State the principles of x-ray production.

2XRA.21.02 Compare the production of the Bremsstrahlung with the production of characteristic radiations.

2XRA.21.03 Describe the conditions necessary to produce x-radiation.

2XRA.21.04 Discuss various photon interactions in terms of description of interaction, relation to atomic number and application.

2XRA.21.05 Define photodisintegration.

2XRA.21.06 Discuss relationships of wavelength and frequency to beam characteristics.

2XRA.21.07 Define units of radiation measurement and provide an example of its application.

2XRA.26.00 DISCUSS THE NEED FOR/PROMOTE PATIENT PROTECTION

2XRA.26.12 Discuss safety factors for the patient (and other patients) in the room during mobile radiographic procedures.

2XRA.27.00 DESCRIBE/EMPLOY PRACTICAL RADIATION PROTECTION MEASURES

2XRA.27.14 Identify emergency procedures to be followed during failures of x-ray mechanisms.

2XRA.28.00 DESCRIBE/DIAGRAMMATICALLY REPRESENT CELL STRUCTURE, CLASSIFICATION AND FUNCTION AND RADIATION EFFECTS ON CELLS

2XRA.28.07 Distinguish between ionizing and non-ionizing radiations.

2XRA.28.08 Identify sources of electromagnetic and particulate ionizing radiations.

2XRA.28.11 Identify sources of radiation exposure.

2XRA.43.00 IDENTIFY/EMPLOY COMPUTER APPLICATIONS IN RADIOLOGY

2XRA.43.01 *Identify various types of computer imaging in radiology (these techniques are fully described under Imaging Equipment of specialized curricular areas).

Required Readings/Materials

You must purchase the following required readings/materials:

Radiologic Science for Technologists, Bushong, 10th Ed.

Radiologic Science for Technologists Student Workbook, Bushong, 10th Ed.

The Integrated Radiography Workbook, 5th Ed.

COURSE REQUIREMENTS:

- A. Regular and punctual attendance of all class lectures and laboratory exercise.
- B. Read and discuss textbook assignments and outside readings when they are assigned.
- C. Complete all course assignments to include worksheets, laboratory exercises, written papers, examinations, etc.
- D. Demonstrate proficiency of the requirements set forth in this course by attainment of a grade of "C" or better.
- E. **Tests** - Students will be allowed to make up tests; however, 10 points will be deducted for each class day a student fails to take the examination. It is the student's responsibility to make an appointment with the instructor for the make-up examination

METHOD OF EVALUATION

Grading Criteria:

Grading Criteria:

A - 93-100

B - 84-92

C - 75-83

Weight of Course Requirements

Weight of Course Requirements

40 % Unit Exams

10 % Workbooks

10 % Instructor Worksheets

40 % Final Examination

ATTENDANCE POLICY

Student attendance at every class, lab and clinical practicum is expected. Students shall be prompt to class and clinical practicums. Points will be deducted from a student's final course grade for absences. (1-2 abs = .5 pt. ea.; 3-5 abs = .75 pt. ea.; 6-7 abs = 1 pt. ea.) A student is considered absent if more than 30 minutes late to lecture or lab or more than 2 hours late for clinical practicums. Four (4) or more absences will constitute an administrative drop.

ACADEMIC ETHICS:

You are expected to complete your own assignments and take tests without notes or other outside assistance. **ALL WORK IS EXPECTED TO BE YOUR OWN.** If unethical behavior is detected, **ALL** parties involved will be denied points for that project or exam. The questioned material and a report of the ethics violation will be submitted to the department chair for further action as deemed necessary by the department chair. Unethical behavior including dishonesty (cheating) on any work can be reason for dismissal from the class and ultimately the Program.

Statement of Academic Dishonesty

Ethics, Cheating and Plagiarism

"Using someone else's ideas or phrasing and representing those ideas of phrasing as our own, either on purpose or through carelessness, is a serious offense known as plagiarism. "Ideas or phrasing" includes written or spoken material, of course, from whole papers and paragraphs to sentences, and indeed, phrases. But it also includes statistics, lab results, art work, etc. "Someone else" can mean a professional source, such as a published writer or critic in a book, magazine, encyclopedia, or journal; an electronic resource such as material we discover on the World Wide Web; another students at our school or anywhere else; a paperwriting "service" (online or otherwise), which offers to sell written papers for a fee." (statement taken from <http://webster.comnet.edu/mla/plagiarism.shtml>)

STUDENT ASSISTANCE:

The following resources are available to assist you in successful completion of this course:

- A. In the LRC - Audiovisual materials from LRC presented during course.
- B. **Smarthinking** (<http://Smarthinking.com>)

Smarthinking Provides live, online, on-demand tutoring and writing assistance to Odessa College students in **Mathematics (Basic Skills - Calculus II), Writing, General Chemistry, Organic Chemistry, Physics, Biology, Introduction to Human Anatomy and Physiology, Accounting, Economics, Introductory Finance, Spanish and Statistics.**

Keep in mind that the Success Center still has 7 outstanding tutors for in-house face-to-face tutoring sessions.

- C. Instructor Assistance - Instructor office hours are posted on their office doors. Instructors are available during these hours to assist students. Some office hours are at the college while others are at clinical affiliates.

SPECIAL NEEDS STATEMENT

Special Needs: Odessa College complies with Section 504 of the Vocational Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990. If you have any special needs or issues pertaining to your access to and participation in this or any other class at Odessa College, please contact Becky Rivera-Weiss in the Office of Disability Services at 432-335-6861 to request assistance and accommodations.

IMPORTANT NOTES

The final examination is a comprehensive examination based on the ARRT format.

MISSED EXAMINATIONS

Students will be allowed to make up tests; however, 10 points will be deducted for each class day a student fails to schedule and complete the examination. It is the student's responsibility to schedule the retake with regards to the instructor's schedule.

Expectations for Engagement – Face to Face Learning

To help make the learning experience fulfilling and rewarding, the following Expectations for Engagement provide the parameters for reasonable engagement between students and instructors for the learning environment. Students and instructors are welcome to exceed these requirements.

Reasonable Expectations of Engagement for Instructors

1. As an instructor, I understand the importance of clear, timely communication with my students. In order to maintain sufficient communication, I will
 - provided my contact information at the beginning of the syllabus;
 - respond to all messages in a timely manner through telephone, email, or next classroom contact; and,
 - notify students of any extended times that I will be unavailable and provide them with alternative contact information (for me or for my supervisor) in case of emergencies during the time I'm unavailable.
2. As an instructor, I understand that my students will work to the best of their abilities to fulfill the course requirements. In order to help them in this area, I will
 - provide clear information about grading policies and assignment requirements in the course syllabus, and
 - communicate any changes to assignments and/or to the course calendar to students as quickly as possible.
3. As an instructor, I understand that I need to provide regular, timely feedback to students about their performance in the course. To keep students informed about their progress, I will
 - return classroom activities and homework within one week of the due date and

- provide grades for major assignments within 2 weeks of the due date or at least 3 days before the next major assignment is due, whichever comes first.

Reasonable Expectations of Engagement for Students

1. As a student, I understand that I am responsible for keeping up with the course. To help with this, I will
 - attend the course regularly and line up alternative transportation in case my primary means of transportation is unavailable;
 - recognize that the college provides free wi-fi, computer labs, and library resources during regular campus hours to help me with completing my assignments; and,
 - understand that my instructor does not have to accept my technical issues as a legitimate reason for late or missing work if my personal computer equipment or internet service is unreliable.
2. As a student, I understand that it is my responsibility to communicate quickly with the instructor any issue or emergency that will impact my involvement with or performance in the class. This includes, but is not limited to,
 - missing class when a major test is planned or a major assignment is due;
 - having trouble submitting assignments;
 - dealing with a traumatic personal event; and,
 - having my work or childcare schedule changed so that my classroom attendance is affected.
3. As a student, I understand that it is my responsibility to understand course material and requirements and to keep up with the course calendar. While my instructor is available for help and clarification, I will
 - seek out help from my instructor and/or from tutors;
 - ask questions if I don't understand; and,
 - attend class regularly to keep up with assignments and announcements.

“The SEI process for face-to-face and online courses is scheduled for the week of November 26th.”

SUMMARY OF ASSIGNMENTS & ACTIVITIES

Item (Name)	Type	Description
Chapter 1 – Essential Concepts of Radiologic Science, pp 2-25	Lecture/Discussion of Key Points	Complete Worksheets & Review Questions
Explores the basic concepts of the science and technology of x-ray imaging to include the study of matter, energy, the electromagnetic spectrum, and ionizing radiation.		
Chapter 2 – The Structure of Matter, pp 26-43	Lecture/Discussion of Key Points	Complete Worksheets & Review Questions
Delves into the study of matter, the atom to include all characteristics of the atom important in radiology such as binding		Quiz

energy, individual electron energy, valence, covalent and ionic bonds, etc.

Chapters 1 & 2 Examination

Chapter 3 – Electromagnetic Energy, pp 44-59

Discusses the electromagnetic spectrum, identifies the properties of photons, explains and allows for work with inverse square law; and defines wave and quantum theory.

**Lecture/Discussion
of Key Points**

**Complete Worksheets
& Review Questions**

Chapter 4 – Electricity, Magnetism, and Electromagnetism, pp 60-81

Briefly introduces the basic concepts of electricity and magnetism needed for further study of the x-ray imaging system and its various components to include electrostatics and electrodynamics and electromagnetic induction and describes the nature of magnetism by discussing the laws that govern magnetic fields which is essential to understanding the function of several components of the x-ray imaging system.

**Lecture/Discussion
of Key Points**

**Complete Worksheets
& Review Questions**

Chapters 3 & 4 Examination

Quiz

Chapter 5 – The X-ray Imaging System, pp 84-103

Describes the components of the operating console of an x-ray machine that is used to control the voltage applied to the x-ray tube, the current through the x-ray tube and the exposure time, discusses the high-voltage generator which contains the high-voltage step-up transformer and the rectification circuit in its many forms, the low-voltage step-down transformer, and finally, combines all components into a single complete circuit diagram.

**Lecture/Discussion
of Key Points**

**Complete Worksheets
& Review Questions**

Chapter 6 – The X-ray Tube, pp 104-122

Explanation of the external components of the x-ray tube and the internal structure of the x-ray tube to include line focus principle, anode heel effect, and causes and prevention of x-ray tube failure with calculation of heat units and the use of tube rating charts, anode cooling curve charts and housing cooling curve charts.

**Lecture/Discussion
of Key Points**

**Complete Worksheets
& Review Questions**

Chapter 5 & 6 Examination

Quiz

Chapter 7 – X-ray Production, pp 123-135

Explain the interactions of the projectile electrons that are accelerated from the cathode to the anode within the x-ray tube resulting in the production of heat and x-rays, the interactions that

**Lecture/Discussion
of Key Points**

**Complete Worksheets
& Review Questions**

produce two types of x-rays, Bremsstrahlung and Characteristic, the x-ray emission spectrum and factors that affect it, and a review of two types of mechanical energy, potential and kinetic, and their involvement in x-ray production.

Chapters 7 Examination

Quiz

Chapter 25 – Fluoroscopy, pp 401-416

**Lecture/Discussion
of Key Points**

**Complete Worksheets
& Review Questions**

Identifies the components to include the input phosphor, photocathode, electrostatic focusing lenses, anode, and output phosphor of an image intensifier tube, learn to calculate flux gain, brightness gain, minification gain and the conversion factor, an explanation of scotopic (rod) and photopic (cone) vision, fluoroscopic technique, veiling glare, contrast resolution, vignetting, spatial resolution and multiframe image intensification to include field of view, magnification factor, automatic brightness control (ABC), and the possible modes of operation with an image-intensifier tube such as spot-film camera, television monitor and cine camera.

Chapter 21 Examination

Quiz

Final Examination – Comprehensive Final Examination

Quiz

Multiple Choice Questions