COURSE SYLLABUS

Department: Radiologic Technology

Course Title: Radiographic Imaging Equipment

Section Name: RADR 2309

Start Date: 08/22/2011

End Date: 12/09/2011

Modality: FACE-TO-FACE

Credits: 3

Instructor Information

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Course Description

A study of the equipment and physics of x-ray production, basic x-ray circuits, and the relationship of equipment 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 an introduction to computed and digital radiography.

Prerequisites/Corequisites

Prerequisite: RADR 1311. Corequisites: RADR 1266, RADR 1303, RADR 2301 and RADR 2309

SCANS

1, 2, 3, 6, 8,11

Course Objectives

LEARNING OUTCOMES:

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. Student will demonstrate an understanding of radiographic/fluoroscopic equipment and an introduction to computed and digital radiography. The student will complete a minimum of 6 of the ARRT ODIA modules for a grade.

COMPUTER PROGRAMS AVAILABLE IN CT 216 (COMPUTER LAB)

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

COURSE COMPETENCIES

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

1XRA.36.03 Discuss the pH scale and differentiate between acid and base substances.
1XRA.36.05 Describe the different types of carbohydrates and give examples of each type.
1XRA.36.06 Describe the different types of lipids and their common characteristics.
1XRA.36.07 Explain the structure and functions of proteins.
1XRA.36.08 Describe the structure of DNA and the law of complementary base pairing.
1XRA.36.09 Describe the structure of RNA and name the different types of RNA.

1XRA.37.00 KNOW CELL STRUCTURE AND EXPLAIN GENETIC CONTROL

1XRA.37.01 Explain the structure of the cell membrane and the cytoskeleton.
1XRA.37.02 Define endocytosis and exocytosis.
1XRA.37.04 Explain the replication of DNA.
1XRA.37.05 Describe the phase of the cell cycle.
1XRA.37.06 Describe genetic transcription and the post-transcriptional modifications that charge pre-mRNA into mRNA.
1XRA.37.07 Describe the functions of mRNA, tRNA, and rRNA.
1XRA.37.08 Explain the mechanisms of genetic translation of the RNA code into the synthesis of proteins.
1XRA.37.09 Describe the functions of the rough endoplasmic reticulum and Golgi apparatus in post-transitional modifications of secretory proteins.
1XRA.37.11 Differentiate between meiosis and mitosis and identify the stages of each process.

1XRA.38.00 UNDERSTAND/DISCUSS METABOLISM

1XRA.38.01 Define anabolism.
1XRA.38.02 Define catabolism.
1XRA.38.03 Define metabolism.

1XRA.39.00 KNOW/DISCUSS TISSUE STRUCTURE AND FUNCTION

1XRA.39.02 List each type of tissue and give an example of a location where each type might be found.
1XRA.39.03 Compare and contrast structural and functional characteristics of each of the tissue classifications.

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

2XRA.21.04 Discuss various photon interactions in terms of description of interaction, relation to atomic number and applications.
2XRA.21.07 Define units of radiation measurement and provide an example of its application.

2XRA.22.00 DISCUSS/IDENTIFY THE NEED FOR RADIATION PROTECTION

2XRA.22.01 Identify and justify the need to minimize unproductive radiation exposure of humans.
2XRA.22.02 Define and distinguish between somatic and genetic radiation effects (immediate and latent), provide examples.
2XRA.22.03 Differentiate between the stochastic and non-stochastic effects of radiation exposure, provide examples.
2XRA.22.04 List the objectives of a radiation protection program and demonstrate the ability to document same.
2XRA.22.05 Identify effective dose equivalent limits for occupational and nonoccupational radiation exposure.
2XRA.22.06 Identify the acronym “ALARA” and describe the concept optimization.

2XRA.22.07 Identify the basis for occupational exposure limits: comparable risk.
2XRA.22.08 Describe the concept of negligible individual risk level (NIRL).
2XRA.22.09 Identify ionizing radiation from natural and man-made sources and list their approximate dose equivalent contributions.
2XRA.22.10 Identify legal and ethical radiation protection responsibilities of radiation workers.

2XRA.23.00 RADIOACTIVITY DETECTION-DISCUSS/DEMONSTRATE METHODS EMPLOYED FOR RADIATION MEASUREMENT
2XRA.23.01 Identify and define units of radiation for exposure, absorbed dose, dose equivalent and radioactivity.
2XRA.23.02 Define and describe the interrelationships between relative biological effectiveness and quality factors.
2XRA.23.03 Describe how the quality factor is used to determine dose equivalent.
2XRA.23.04 State why the Sievert is the appropriate unit for radiation protection work.
2XRA.23.05 Describe the theory and operation of the following radiation detection devices: ion-chambers; proportional counter; thermoluminescent dosimeters (TLD's).
2XRA.23.06 List the appropriate applications and limitations for each radiation detection device above.

2XRA.24.00 DISCUSS/DESCRIBE RADIATION SURVEYS AND IDENTIFY REGULATORY AGENCIES AND REGULATIONS
2XRA.24.01 State when a radiation protection survey should be conducted.
2XRA.24.02 Identify who should conduct the survey.
2XRA.24.03 Describe the conditions under which radiation protection surveys of equipment are made.
2XRA.24.04 Identify the various performance standards for beam directing, beam defining and beam limiting devices which are evaluated in a radiation protection equipment survey of:
2XRA.24.05 Describe procedures used to verify performance standards for equipment in 24.04, indicate potential consequences of performance standard failure.
2XRA.24.06 Describe the operation of various interlocking systems for equipment in 24.04, indicate potential consequences of interlock system failure.
2XRA.24.07 List conditions and locations evaluated in an survey for radiation protection.
2XRA.24.08 Distinguish between controlled and non-controlled areas and list acceptable exposure levels.
2XRA.24.09 Describe "RADIATION AREA" signs and identify appropriate placement sites.
2XRA.24.10 Identify the functions of the following agencies:
2XRA.24.11 Discuss the Consumer-Patient Radiation Health and Safety Act of 1981.
2XRA.24.12 Describe the function of various state and local regulations governing radiation protection practices.
2XRA.24.13 Describe the requirements and responsibilities for a radiation protection officer.

2XRA.25.00 DESCRIBE/EMPLOY PERSONNEL MONITORING AND IDENTIFY OCCUPATIONAL EXPOSURES
2XRA.25.01 Identify the need and importance of personnel monitoring for radiation workers.
2XRA.25.02 Identify and describe the following monitoring devices:
2XRA.25.03 List applications, advantages and limitations for each device in 25.02.
2XRA.25.04 Interpret personnel monitoring reports.
2XRA.25.05 List values for maximum permissible dose equivalent limits for occupational radiation exposures (annual and lifetime).
2XRA.25.06 Identify those structures which are considered critical for potential late effects for whole body irradiation exposure.
2XRA.25.07 Identify dose equivalent limits for embryo and fetus in occupationally exposed women.

2XRA.25.08 State the age proportion formula for the determination of a maximum accumulated dose equivalent.

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

2XRA.26.03 Explain the purpose and importance of patient shielding.
2XRA.26.05 Explain the ten day rule and its application to female patients of childbearing age.
2XRA.26.09 Discuss the importance of clear, concise instructions (effective communication skills) as a method of radiation protection.
2XRA.26.11 Describe the minimum source-to-tabletop distances for fixed and mobile fluoroscopes.
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.27.01 Identify barrier materials and their use in specific x-ray installations.
2XRA.27.02 Distinguish between primary and secondary barriers.
2XRA.27.03 Describe how Use (U) influences the design of x-ray installations.
2XRA.27.04 Describe hoe Workload (W) influences the design of x-ray installations.
2XRA.27.05 Describe how Occupancy (T) influences the design of x-ray installations.
2XRA.27.06 Describe how Distance (T) influences the design of x-ray installations.
2XRA.27.07 Describe how Material influences the design of x-ray installations.
2XRA.27.08 Describe how the operation of various ancillary equipment influences radiation safety and describe the potential consequences of failure of this equipment.
2XRA.27.09 Describe how the operation of various x-ray equipment influences radiation safety and describe the potential consequences of failure of this equipment.
2XRA.27.10 Identify who should evaluate ancillary/x-ray equipment; frequency evaluations should be made; how is this related to the Quality Assurance Program for radiation safety.
2XRA.27.11 Demonstrate how time, distance and shielding can be manipulated to keep radiation exposures to a minimum.
2XRA.27.12 Perform calculations of exposure with varying time, distance and shielding.
2XRA.27.13 Discuss the relationship between half-value layer and shielding design.
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.28.01 Identify important functions of organic and inorganic cell constituents.
2XRA.28.02 List and describe the function of various cell structures and organelles.
2XRA.28.03 Describe the structure and function of the nucleus.
2XRA.28.04 Identify events occurring in mitosis and meiosis and describe each process.
2XRA.28.05 List the sequence of events in the cell cycle.
2XRA.28.06 Define differentiation.
2XRA.28.07 Distinguish between ionizing and non-ionizing radiations.
2XRA.28.08 Identify sources of electromagnetic and particulate ionizing radiations.
2XRA.28.09 Define directly ionizing radiations.
2XRA.28.10 Define indirectly ionizing radiations.
2XRA.28.11 Identify sources of radiation exposure.

2XRA.29.00 DISCUSS/DESCRIBE BIOPHYSICAL EVENTS

2XRA.29.01 Identify and distinguish between the physical and biologic units of radiation dose.
2XRA.29.02 Identify radiation induced chemical reactions resulting in the production of free radicals.
2XRA.29.03 Describe how free radical production causes biologic damage.
2XRA.29.04 Define LET and RBE.

2XRA.29.05 List and describe factors that influence RBE.

2XRA.30.00 DESCRIBE/MINIMIZE RADIATION EFFECTS

2XRA.30.01 Identify and describe types of biologic effects from radiation at the subcellular level.
2XRA.30.02 State how subcellular radiation effects are expressed in humans.
2XRA.30.03 Identify and describe types of biologic effects from radiation at the cellular level.
2XRA.30.04 State how cellular radiation effects are expressed in humans.
2XRA.30.05 Define somatic, stochastic and genetic radiation effects.
2XRA.30.06 Identify specific diseases or syndromes associated with the effects in 30.05
2XRA.30.07 Identify methods to measure radiation response.
2XRA.30.08 List physical, chemical and biologic factors influencing response.
2XRA.30.09 Distinguish between lethal and sublethal response and identify factors which influence response.

2XRA.31.00 DISCUSS RADIOSENSITIVITY AND RESPONSE AND MANIPULATE FACTORS TO MINIMIZE

2XRA.31.01 Define radiosensitivity.
2XRA.31.02 Describe how the radiosensitivity of tissues relate to mitotic rate and degree of differentiation.
2XRA.31.03 List factors influencing radiosensitivity.
2XRA.31.04 Identify various survival curve parameters.
2XRA.31.05 State how LET, oxygen and fractionation influence the shape of survival curves.
2XRA.31.06 Describe the clinical implications of those factors which influence survival curves.
2XRA.31.07 Associate the expected responses to radiation with the appropriate dose levels for the hemopoietic system.
2XRA.31.08 Associate the expected responses to radiation with the appropriate dose levels for the skin.
2XRA.31.09 Associate the expected responses to radiation with the appropriate dose levels for the digestive system.
2XRA.31.10 Associate the expected responses to radiation with the appropriate dose levels for the urinary system.
2XRA.31.11 Associate the expected responses to radiation with the appropriate dose levels for the respiratory system.
2XRA.31.12 Associate the expected responses to radiation with the appropriate dose levels for the reproductive system.
2XRA.31.13 Associate the expected responses to radiation with the appropriate dose levels for the nervous system.
2XRA.31.14 Identify factors influencing the degree of responses.
2XRA.31.15 Define and distinguish between the different levels of tolerance above.
2XRA.31.16 State the clinical significance of LD 50/30 and LD 30.
2XRA.31.17 Identify factors influencing tolerance of various tissues.
2XRA.31.18 Given specific tissue sites, state the tolerance dose.
2XRA.31.19 Describe conditions which result in a radiation syndrome.
2XRA.31.20 Associate the various stages of a radiation syndrome with the appropriate dose levels.
2XRA.31.21 Describe factors which influence responses in a radiation syndrome.
2XRA.31.22 Identify possible medical interventions used to modify a radiation syndrome.
2XRA.31.23 Define and identify possible radiation induced somatic effects.
2XRA.31.24 Define and identify possible radiation induced stochastic effects.
2XRA.31.25 Define and identify possible radiation induced genetic effects.

Required Readings/Materials

You must purchase the following required readings/materials:

Radiologic Science for Technologists, Bushong, 9th Ed.
Radiologic Science for Technologists Student Workbook, Bushong, 9th 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

35 % Unit Exams
10 % ARRT ODIA modules
5 % 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.commnet.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.

SUMMARY OF ASSIGNMENTS & ACTIVITIES

Item (Name)	Type	Description
Chapter 1 – Concepts of Radiologic Science, pp 2-15 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.	**Lecture/Discussion of Key Points**	**Complete Worksheets & Review Questions**
Chapter 2 – Fundamentals of Radiologic Science, pp 16-36 Defines and illustrates the units of measurement to include radiation and radioactivity units used in medical imaging with a brief review of mathematics with emphasis on mathematics that applies to x-ray imaging: number systems, algebra, exponents, and graphing.	**Lecture/Discussion of Key Points**	**Complete Worksheets & Review Questions**
Chapter 3 – The Structure of Matter, pp 37-55	**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 energy, individual electron energy, valence, covalent and ionic bonds, etc.

Chapters 1, 2 & 3 Examination — **Quiz**

Chapter 4 – Electromagnetic Energy, pp 56-71 — **Lecture/Discussion of Key Points** — **Complete Worksheets & Review Questions**

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

Chapter 5 – Electricity, Magnetism, and Electromagnetism, pp 72-97 — **Lecture/Discussion of Key Points** — **Complete Worksheets & Review Questions**

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.

Chapters 4 & 5 Examination — **Quiz**

Chapter 6 – The X-ray Imaging System, pp 100-118 — **Lecture/Discussion of Key Points** — **Complete Worksheets & Review Questions**

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 n its many forms, the low-voltage step-down transformer, and finally, combines all components into a single complete circuit diagram.

Chapter 7 – The X-ray Tube, pp 119-137 — **Lecture/Discussion of Key Points** — **Complete Worksheets & Review Questions**

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.

Chapter 6 Examination — **Quiz**

Chapter 8 – X-ray Production, pp 138-150 — **Lecture/Discussion of Key Points** — **Complete Worksheets & Review Questions**

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 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 & 8 Examination		**Quiz**
Chapter 21 – Fluoroscopy, pp 346-352 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 multifield 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.	**Lecture/Discussion of Key Points**	**Complete Worksheets & Review Questions**
Chapter 21 Examination		**Quiz**
Final Examination – Comprehensive Final Examination **Multiple Choice Questions**		**Quiz**