

## SYLLABUS

- Name of Course:** X-Ray Physics (ACS - 231)
- Length of Course:** 2 units, 33 hours
- Course Description:** This course is an introduction to the physics of x-ray. Photon production, projection, collimation, attenuation and image formations are among the topics considered. The various components of x-ray systems are studied as are the fundamentals of darkroom procedure. Emphasis is placed on the biological effects of ionizing radiation and on patient protection.
- Prerequisites:** ACS-313, ACS-813
- Course Offered by:** Clinical Sciences Department
- Required Text:** Bushong SC. *Radiologic Science for Technologists*. 9th ed. 2008  
*X-Ray Physics Class Notes*
- Recommended Text:** Guebert GM. *Essentials of Diagnostic Imaging*. 1995
- Reference Texts:** None
- Materials:** DVD's of lectures (available in library)
- Method of Instruction:** Lecture-discussion
- Evaluation/Grading Criteria:** The course will have one 40 point written midterm (short fill-in), one 80 point comprehensive final written (scantron).

Written midterm	40
Written final	80

A	108-120 pts.
B	96-107 pts.
C	84-95 pts.
F	83 pts. and below

Grades and the Grading System Final grades are available online through the CAMS student portal. If there are any questions on grading procedures, computation of grade point average, or the accuracy of the grade report, please contact the Registrar's Office or the Office of Academic Affairs. Grades will be reported and evaluation will be based on the Academic Policies, Procedures, & Services. Please refer to Evaluation Policy (**Policy ID: OAA.00007**)

- Attendance:** Please refer to Attendance Policy (**Policy ID: OAA.00002**)
- Conduct and Responsibilities:** Please refer to the Personal Conduct, Responsibility and Academic Responsibility Policy (**Policy ID: OAA.00003**)
- Make-up Exams:** Please refer to Make-up Assessment Policy (**Policy ID: OAA.00001**)
- Request for Special Testing:** Please refer to Request for Special Testing (**Policy ID: OAA.00004**)

**Accommodation for Students with Disabilities:**

If you have approved accommodations, please make an appointment to meet with your instructor as soon as possible. If you believe you require an accommodation, but do not have an approved accommodation letter, please see the Academic Counselor Lori Pino in the Office of Academic Affairs. Contact info: [Lpino@lifewest.edu](mailto:Lpino@lifewest.edu) or 510-780-4500 ext. 2061. Please refer to Service for Students with Disabilities Policy (**Policy ID: OAA.00005**)

**Electronic Course Management:**

**Canvas** is LCCW’s Learning Management System (LMS). Canvas will be used throughout the quarter during this course. Lectures, reminders, and messages will be posted. In addition, documents such as the course syllabus and helpful information about the class project will be posted. Students are expected to check Canvas at least once a week in order to keep updated. The website address for Canvas is <https://lifewest.instructure.com/login/canvas>. Please refer to the Educational Technologies Policy (**Policy ID: OAA.00009**)

**Course Goals:** The goal of this course is to prepare the student to understand the basic concepts needed to operate an X-ray machine and produce quality radiographs (both film based and digitally). In addition, the student will understand basic concepts in radiobiology as it pertains to the human body.

**Course Objectives:**

**Week 1** -to introduce differences in state regulations regarding operator permit  
 -to introduce basic principles of the discovery of X-rays and the early history of X-ray

Introduction  
 Discovery of X-ray  
 Early history of X-ray

**Week 2** -to introduce concepts of MAS and KV  
 -to discuss the functional components of the X-ray tube

Xray tube  
 - cathode - anode  
 Tube housing

Useful beam  
Small vs. Large focal spot  
Focusing cup  
Stationary anode  
Rotating anode  
Induction motor  
KV vs. MAS

**Week 3** -to discuss the various types of X-ray generators  
-to discuss the effects of heat on the tube  
-to introduce the line focus principle

Xray generators  
- Single phase  
- 3 phase  
- High frequency  
Timer accuracy  
Tube rating chart  
Heat unit  
Anode colling chart  
Life focus principle  
Penumbra

**Week 4** - to discuss geometric factors  
- to understand the anode heel effect  
- to differentiate type of filters  
- to discuss the inverse square law  
- to understand the relationship of contrast and density  
- to comprehend the importance of the inverse square law  
- to discuss the types of primary radiation

FFD, TID, SID, OFD, OID

Anode heel effect  
Primary radiation  
- bremsstrahlung  
- characteristic

Primary filter/HVL  
Compensating filters  
Inverse Square Law  
15% rule & Contrast vs. Density

**Week 5** - to understand the types of secondary radiation and how to minimize its deleterious effects

Secondary interactions  
- classical  
- compton  
- photoelectric effect  
- pair production

- nuclear fragmentation

Grid

Bucky

Grid cut off

FOV vs scatter

Grids and effects on scatter, contrast, detail, dose

Air gap technique

**Week 6**      Written midterm

- to discuss the grids
- to understand darkroom considerations
- to discuss intensifying screens

Grid frequency

Non bucky exposures

Filter

- components

- speed

- color sensitivity

Fog

Processing

Intensifying screens

System speeds

**Week 7**      - to describe screen care and film processing  
                  - to understand digital radiography

System speeds

Cleaning screens

Processing

- manual

- automatic

CR

DR

-Single detector CCD

-multidetector CCD

-Indirect flat plate

-PACS

**Week 8**      -to describe the importance of beam restriction and methods to achieve it  
                  -to describe densitometry and its uses

Beam limiting devices

- single aperture diaphragm

- cone/cylinder

- variable aperture diaphragm

Densitometry  
H & D curve

**Week 9** -to describe radiobiologic measurements  
-to determine types of dose measurement

Law of Bergonie & Tribondeau  
Roentgen  
RAD  
REM  
Nomogram  
Skin entrance dose  
Whole body dose  
Bone marrow dose  
Thyroid dose  
Genetically significant dose

**Week 10** -to understand occupational exposure

- Occupational exposure  
- quarterly dose  
- yearly dose  
- total accumulated dose  
Gonadal shields  
10 day rule  
Automatic exposure control  
Film badge  
TLD's  
Pocket ionization chambers  
Primary and secondary leading

**Week 11** - Final written  
- Review (if time permits)

### **Student Learning Outcomes:**

1. The student will understand how the X-ray machine operates. [PLO: 1,3,4]
2. The student will understand the technical factors of MAS and KV. [PLO: 1,3,4]
3. The student will recognize the geometric factors that contribute to image production. [PLO: 1]
4. The student will understand how to deal with scatter radiation. [PLO: 1,5]
5. The student will understand the difference between plain film image production and digital. [PLO: 1,2,4,6]

6. The student will understand quality assurance parameters. [PLO: 1,2,4,6]

7. The student will understand radiobiology issues in the diagnostic range of x-ray. [PLO: 1,3,4,6]

**Program Learning Outcomes (PLO):** Students graduating with a Doctor of Chiropractic degree will be proficient in the following:

- 1. ASSESSMENT AND DIAGNOSIS:** An assessment and diagnosis requires developed clinical reasoning skills. Clinical reasoning consists of data gathering and interpretation, hypothesis generation and testing, and critical evaluation of diagnostic strategies. It is a dynamic process that occurs before, during, and after the collection of data through history, physical examination, imaging, laboratory tests and case-related clinical services.
- 2. MANAGEMENT PLAN:** Management involves the development, implementation and documentation of a patient care plan for positively impacting a patient's health and well-being, including specific therapeutic goals and prognoses. It may include case follow-up, referral, and/or collaborative care.
- 3. HEALTH PROMOTION AND DISEASE PREVENTION:** Health promotion and disease prevention requires an understanding and application of epidemiological principles regarding the nature and identification of health issues in diverse populations and recognizes the impact of biological, chemical, behavioral, structural, psychosocial and environmental factors on general health.
- 4. COMMUNICATION AND RECORD KEEPING:** Effective communication includes oral, written and nonverbal skills with appropriate sensitivity, clarity and control for a wide range of healthcare related activities, to include patient care, professional communication, health education, and record keeping and reporting.
- 5. PROFESSIONAL ETHICS AND JURISPRUDENCE:** Professionals comply with the law and exhibit ethical behavior.
- 6. INFORMATION AND TECHNOLOGY LITERACY:** Information literacy is a set of abilities, including the use of technology, to locate, evaluate and integrate research and other types of evidence to manage patient care.
- 7. CHIROPRACTIC ADJUSTMENT/MANIPULATION:** Doctors of chiropractic employ the adjustment/manipulation to address joint and neurophysiologic dysfunction. The adjustment/manipulation is a precise procedure requiring the discrimination and identification of dysfunction, interpretation and application of clinical knowledge; and, the use of cognitive and psychomotor skills.
- 8. INTERPROFESSIONAL EDUCATION:** Students have the knowledge, skills and values necessary to function as part of an inter-professional team to provide patient-centered collaborative care. Inter-professional teamwork may be demonstrated in didactic, clinical or simulated learning environments.
- 9. BUSINESS:** Assessing personal skills and attributes, developing leadership skills, leveraging talents and strengths that provide an achievable expectation for graduate success. Adopting a systems-based approach to business operations. Networking with practitioners in associated fields with chiropractic, alternative medicine and allopathic medicine. Experiencing and acquiring the hard business skills required to open and operate an on-going business concern. Participating in practical, real time events that promote business building and quantifiable marketing research outcomes
- 10. PHILOSOPHY:** Demonstrates an ability to incorporate a philosophically based Chiropractic paradigm in approach to patient care. Demonstrates an understanding of both traditional and contemporary Chiropractic philosophic concepts and principles. Demonstrates an understanding of the concepts of philosophy, science, and art in chiropractic principles and their importance to chiropractic practice.