

## SYLLABUS

COURSE: DHCT 2105 Dental Radiology I  
SEMESTER: Fall  
CREDIT HOUR: 3.0

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## GOAL

The purpose of this course is to introduce the dental hygiene student to the basic radiologic principles of intraoral imaging for dento-alveolar structures. The radiographic examination plays an integral role in the diagnostic process in dentistry in conjunction with the clinical examination. The dental hygienist must be proficient with intraoral techniques to fulfill their roles as health care providers.

As clinicians, dental hygienists must have an understanding of the basic concepts of radiographic imaging modalities in order to maximize the diagnostic potential of these procedures for their patients. The preclinical laboratory sessions are designed to perfect technical skills and familiarize dental hygiene students with the variability of normal radiographic anatomy seen on intraoral radiographs.

## OBJECTIVES

### I. RADIATION HISTORY

1. Explain the historical contribution each of the following scientists made to the development of dental radiography.
  - 1.1 Wilhelm Conrad Roentgen
  - 1.2 Otto Walkhoff
  - 1.3 C. Edmund Kells
2. Define and discriminate between the following terms:
  - 2.1 radiology
  - 2.2 radiography
  - 2.3 radiation.
3. List the uses of dental radiographs.

### II. RADIATION PHYSICS

1. Describe how electrons, protons and neutrons are arranged in the structural integrity of the atom.
2. Differentiate between particulate (corpuscular), gamma, and electromagnetic radiations.
3. Correlate the significance of an electron's binding energy and the location of its orbital shell from the nucleus of the atom.
4. Define ionization.
5. List four (4) common characteristics of electromagnetic radiations.
6. Describe the relationship between wavelength and frequency to the energy level in electromagnetic radiations.
7. Compare the relative wavelength frequency of x-radiation to other commonly utilized radiations in the electromagnetic spectrum.
8. Identify the parts and components of a dental X-ray machine. (Fig. 2-11)
9. Identify the following components of an x-ray tube and state their function:
  - 9.1 Cathode
    - 9.1.1 molybdenum (focusing) cup
    - 9.1.2 tungsten filament
  - 9.2 Anode
    - 9.2.1 tungsten target
    - 9.2.2 copper stem
  - 9.3 Leaded glass housing (Glass envelope)
  - 9.4 Collimator
  - 9.5 Window
  - 9.6 Positioning-Indicating Device (PID, a.k.a. BID)

### 9.7 Aluminum Disks (Filters)

10. Define thermionic emission and state its function in x-ray production
11. Differentiate between the low voltage transformer, high voltage transformer and the autotransformer.
12. Describe and quantify the main type of energy conversion occurring at the anode.
13. Define and differentiate between characteristic and Bremsstrahlung (i.e., braking) radiation.
14. Define the terms "ampere", "volt" and "resistance" as they relate to electrical conductivity.
15. Discuss the relationship between alternating current (AC) and direct current (DC) on:
  - 15.1 rectification of the electrical circuits in the x-ray machine
  - 15.2 impulse production at the target of an x-ray tube
16. Discuss how the controls for milliamperage (mA), kilovoltage (kVp), and time (impulses) affect the output of x-ray production in a dental x-ray machine.
17. State three (3) possible outcomes for X-ray photons that penetrate a patient.
18. State four (4) types of x-ray beam absorption.

### III. RADIATION AND DENTAL X-RAY CHARACTERISTICS

1. Identify the components of a dental x-ray unit control panel. (Fig 3-1)
2. State the relationship between focal spot size and image definition.
3. State the effect of mA and exposure time on beam intensity.
4. State the effect of kV on beam intensity.
5. Define the half value layer.
6. Define the Inverse Square Law.
7. Calculate intensity and distance variables using the Inverse Square Law.
8. Define image "density" and image "contrast".
9. Describe how variations in mA, exposure time (impulses) and kilovoltage (kVp) will affect the radiographic image.
10. Differentiate between short-scale (high) and long-scale (low) contrast.
11. Define penumbra and describe how it is affected by changes in source-object and object-film distances.
12. Describe how magnification is affected by source-object and object-film distances.

IV. PARALLELING AND BISECTING TECHNIQUE

1. Differentiate between "paralleling" and "bisecting angle" techniques for intraoral radiographic projections.

V. RADIATION BIOLOGY

1. Differentiate between ionization, excitation and free radical formation.
2. Differentiate between direct and indirect effects of ionizing radiation.
3. List three (3) factors which determine a cell's response to radiation exposure.
4. Identify the deleterious sequelae of ionizing radiation on water.
5. Define the standard and metric terms used to measure radiation:
  - 5.1 Roentgen
  - 5.2 Rad
  - 5.3 Rem
  - 5.4 Gray
  - 5.5 Sievert.
6. Define "Quality Factor" and its relationship to dose equivalence.
7. State sources of background radiation and the average daily whole body dose.
8. List the four (4) critical organs that are more susceptible to the effects of dental radiographic procedures. State the relative risk associated with each organ and the threshold dose necessary to acquire this risk.
9. Compare the relative risk of morbidity from dental x-rays to common industrial activities and social behaviors.
10. Rank common human tissue cell types into a relative order of radiosensitivity.
11. Define the "latent period" with regard to radiation exposure.
12. Define "lethal dose", "threshold dose" and "LD<sub>50/30</sub>" as they relate to the dose response curve.
13. List three (3) determinants of radiation injury.
14. List five (5) symptoms of the "Acute Radiation Syndrome".
15. List the deleterious (harmful) effects of high radiation doses on the tissues of the oral cavity.
16. Describe the pathologic processes associated with "radiation caries" and "osteoradionecrosis".
17. Discuss the significance of a risk versus benefit ratio in radiology.

VI. RADIATION PROTECTION

1. Define Maximum Permissible Dose (MPD)

2. List the Maximum Permissible Doses for:
  - 2.1 occupationally exposed individuals
  - 2.2 non-occupationally exposed individuals
  - 2.3 occupationally exposed but pregnant individuals
3. State the determination of the Maximum Accumulated Dose.
4. Differentiate between “inherent” and “added” filtration.
5. State the NCRP total aluminum filtration recommendations for different kV beams.
6. List seven (7) variables that minimize somatic exposure of patients.
7. Describe the optimal operator positioning during radiographic exposures of the patient.
8. Identify the type of radiation monitoring device used in dental offices.
9. State the importance of radiation monitoring devices.

VII. RADIOGRAPHIC ANATOMY OF THE DENTO-ALVEOLAR PROCESS

1. Based on their radiographic appearance, differentiate between maxillary and mandibular anterior teeth.
2. Based on their radiographic appearance, differentiate between maxillary and mandibular posterior teeth.
3. Identify characteristic periapical anatomy in different parts of the maxilla and mandible based on their radiographic appearance.
4. Identify the intraoral radiographic appearance of restorative materials that restore:
  - 4.1 parts or most of the dental crown
  - 4.2 root canal space
  - 4.3 entire segments of missing teeth

VIII. DENTAL FILM, DIGITAL SENSORS AND IMAGE PROCESSING

1. Identify the components of an intraoral film packet.
2. List the component layers that make up:
  - 2.1 a sheet of dental film.
  - 2.2 charge coupled device (CCD)
  - 2.3 photostimulable phosphor (PSP) plate
3. Differentiate between the sizes and speeds of commercially available intraoral film and digital sensors.
4. Identify the two methods for acquiring direct radiographic images in digital form.
5. List the hazards from which;
  - 5.1 dental film must be protected during storage.

- 5.2 PSP Plates must be protected during storage
6. Define the "latent image."
7. List the major components and their functions for:
  - 7.1 x-ray developer solution
  - 7.2 x-ray fixer solution
8. List the sequential steps for manual and automatic processing of x-ray films.
9. List the requirements of an efficient darkroom.
10. State the requirements for proper darkroom safelights.
11. Describe the mechanism of image formation for the following direct digital radiography systems:
  - 11.1 CCD
  - 11.2 PSP
12. Define the following digital detector characteristics
  - 12.1 Contrast resolution
  - 12.2 Spatial resolution
  - 12.3 Detector latitude
  - 12.4 Detector Sensitivity
13. List and describe the two types of digital image displays
  - 13.1 CRT
  - 13.2 TFT
14. Identify and correct technical errors on intraoral film and sensors that are related to:
  - 14.1 film positioning
  - 14.2 film exposure
  - 14.3 film handling
  - 14.4 film processing
15. Identify advantages and disadvantages of digital technology as it relates to radiology.
16. List the different image enhancement tools available for digital image formats.

IX. INTERPROXIMAL, PERIAPICAL AND PERIODONTAL EVALUATION OF TEETH

1. List two (2) types of intraoral radiographic techniques useful for the recognition of interproximal dental caries.
2. State the horizontal and vertical angulation criteria necessary for the recognition of interproximal dental caries.
3. List the caries incidence for the different teeth in the permanent dentition.

4. State the frequency interval for bitewing radiographic examinations as recommended by the 2004 FDA guidelines.
5. Differentiate between cervical, cemental, recurrent and arrested caries.
6. Define four (4) relative categories of interproximal caries severity.
7. Describe how cervical burnout occurs.
8. Describe the periapical radiographic changes occurring with apical periodontitis.
9. Differentiate the radiographic appearance of periapical disease from:
  - 9.1 superimposing anatomic foraminae
  - 9.2 developing root apices
10. Differentiate between the following radiographic changes in periapical diseases
  - 10.1 apical abscess
  - 10.2 apical granuloma
  - 10.3 apical cyst
  - 10.4 internal and external root resorption
  - 10.5 condensing osteitis
11. List six (6) predisposing factors to periodontal disease that can be recognized on intraoral radiographs.
12. List the advantages and disadvantages of intraoral radiography in evaluating a patient's periodontal status.
13. List four (4) radiographic signs of early to moderate periodontal disease.
14. List four (4) radiographic signs of severe periodontal disease.
15. Differentiate between horizontal and vertical bone loss.
16. Define the "crown:root" ratio and describe its usefulness in radiographic evaluations of periodontal prognosis.

## RESOURCES

### I. Media Resources

#### Printed Media

##### Required textbook

Iannucci J. and Howerton L. J.  
*Dental Radiography. Principles and Techniques*, 3<sup>rd</sup> ed.  
W.B. Saunders Company 2006, 526p.

Langlais, R.P.  
*Exercises in Oral Radiography and Interpretation*, 4<sup>th</sup> Ed.  
W.B. Saunders, 2004, 381p.

### II. Human Resources

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Sr. Support Specialist

## STUDY PLANS AND REQUIREMENTS

This course is to be completed by the end of the Fall semester of the first year of the dental hygiene program.

### ATTENDANCE

You must attend all lectures and the lab sessions to which you are assigned. Punctuality is essential; we have limited facilities and the scheduling is complex. We therefore regret that the laboratory sessions cannot be re-assigned. Each lab session is of 50 minutes duration.

You will be penalized for any unexcused absence as stipulated in the evaluation methods. Students must also be on time. Late arrivals are disruptive. Consequently students arriving later than 10 minutes after the hour will be counted as an unexcused absence.

The schedules for the lectures and lab sessions are listed on the following four pages. Laboratory sessions will be held in the Radiology Clinic area.

To prepare for this course:

1. Review the objectives.
2. Study the appropriate sections in *Dental Radiography, Principles and Techniques*, 3<sup>rd</sup> ed., by Iannucci J. and Howerton L. J
3. Pay particular attention to all illustrations found in these sections of your text.

**DHCT 2105 DENTAL RADIOLOGY I**  
**2009 Fall Semester Lecture Schedule**

Day/Time: Monday & Friday, 9:00-9:50 am; Room 446  
 See schedule for exceptions in **bold**

DATE	DAY	SESSION TOPICS	REFERENCE TEXT
08/17	Mon	Course Overview History of Dental Radiology Review of BW Technique segment of UTDB Training Tape	1) Chapter 17-19 1) Chapter 1
08/21	Fri	Review of Lab Techniques – RINN XCP Training Tape	
08/24	Mon	Physics of Radiation and The X-Ray Machine I	1) Chapter 2
08/28 <b>9-10:50 am</b>	Fri	Physics of Radiation and The X-Ray Machine II Physics of Radiation and The X-Ray Machine III	1) Chapter 2 1) Chapter 2, 3
08/31	Mon	Physics of Radiation and The X-Ray Machine IV	1) Chapter 2, 3
09/04	Fri	<b>Lab Slide Exam</b> <b>ROOM 207</b> <i>( Recognition of XCP components)</i>	Rinn XCP Manual
09/07	Mon	<i>Labor Day Holiday</i>	
09/11	Fri	Principles of X-Ray Tube Operation	1) Chapter 3, 6
09/14	Mon	Technical Aspects of Radiation Production I	1) Chapter 8, 17, 18
09/18	Fri	Technical Aspects of Radiation Production II	1) Chapter 8, 17, 18
09/21	Mon	TBA	
09/25	Fri	<b>Written Examination</b> <b>ROOM 207</b>	
09/28	Mon	Radiation Biology I	1) Chapter 4
10/02 <b>9-10:50 am</b>	Fri	Radiation Biology II	1) Chapter 4 Handout
10/05	Mon	Radiation Protection I	1) Chapter 4
10/09	Fri	Radiation Protection II	1) Chapter 5, 6
10/12	Mon	Radiographic Appearance of Restorative Materials	1) Chapter 31 2) Section 3
10/16 <b>9-10:50 am</b>	Fri	Radiographic Anatomy In The Maxilla	1) Chapter 26 2) Section 1
10/19	Mon	Radiographic Anatomy In The Mandible	1) Chapter 26 2) Section 1
10/23 <b>10-10:50 am</b>	Fri	<b>Written Examination</b> <b>ROOM 207</b>	
10/26	Mon	Image Receptors: Film	1) Chapter 7
10/30 <b>10-10:50 am</b>	Fri	<b>Slide Examination</b> <b>ROOM 207</b> <i>(Recognition of Radiographic Anatomy and Restorative Materials)</i>	

DATE	DAY	SESSION TOPICS	REFERENCE TEXT
11/02	Mon	Image Receptors: Digital	1) Chapter 7
11/06 <b>9-10:50 am</b>	Fri	Analysis of Technical Errors and Artifacts, Part I Analysis of Technical Errors and Artifacts, Part II	1) Chapter 7 1) Chapter 9, 10 2) Section 2
11/09	Mon	Analysis of Technical Errors and Artifacts, Part III	1) Chapter 9, 10 2) Section 2
11/13 <b>9-10:50 am</b>	Fri	Analysis of Technical Errors and Artifacts, Part IV Analysis of Technical Errors and Artifacts, Part V	1) Chapter 9, 10 2) Section 2
11/16	Mon	The Interproximal Examination: Caries Detection	1) Chapter 32
11/20	Fri	<b>Slide Examination</b> <b>ROOM 207</b> <i>(Recognition of Faulty Images)</i>	
11/23	Mon	The Periapical Examination: Recognition of Pathology	1) Chapter 34
11/27	<i>Fri</i>	<i>Thanksgiving Holiday</i>	
11/30	Mon	The Periodontal Evaluation I	1) Chapter 33
12/04	Fri	The Periodontal Evaluation II	1) Chapter 33
<b>12/09</b> <b>1-2:50 pm</b>	<b>WED</b>	<b>Final Comprehensive</b> <b>Written Examination</b> <b>ROOM 207</b>	

REFERENCE TEXTS:

- 1) Iannucci J. and Howerton L. J., *Dental Radiography. Principles and Techniques*, 3<sup>rd</sup> ed., W.B. Saunders Company 2006, 526p.
- 2) Langlais, R.P., *Exercises in Oral Radiology and Interpretation*. 4<sup>th</sup> ed., W.B. Saunders, 2004, 381p.

**DHCT 2105 DENTAL RADIOLOGY I**  
**2009 Fall Semester Laboratory Schedule**

Day/Time: Tuesday, Wednesday, Thursday & Friday (8-8:50 am)

DATE	DAY	GROUP	PROCEDURE
08/18	Tue	A	Demonstration of x-ray tube head, Dental X-ray Teaching and Training
08/19	Wed	B	Replica (DXTTR), control panel, exposure factors, processors and darkroom.
08/20	Thu	C	Using F-Speed film with eXtension Cone Paralleling (XCP), expose the
08/21	Fri	D	maxillary and mandibular centrals & <b>RIGHT</b> anterior periapical views. <i>Process and mount.</i>
08/25	Tue	A	Using F-Speed film with XCP, expose the <b>RIGHT</b> maxillary and
08/26	Wed	B	mandibular premolar and molar periapical views.
08/27	Thu	C	
08/28	Fri	D	<i>Process and mount.</i>
09/01	Tue	A	Using F-Speed film with XCP, expose the <b>RIGHT</b> premolar and molar
09/02	Wed	B	bitewing (BW) views.
09/03	Thu	C	
09/04	Fri	D	<i>Process and mount.</i>
09/08	Tue	A	Using F-Speed film with XCP, expose the <b>LEFT</b> premolar and molar
09/09	Wed	B	BW views.
09/10	Thu	C	
09/11	Fri	D	<i>Process and mount.</i>
09/15	Tue	A	Using F-Speed film with XCP, expose the maxillary and mandibular <b>LEFT</b>
09/16	Wed	B	anterior periapical views.
09/17	Thu	C	
09/18	Fri	D	<i>Process and mount.</i>
09/22	Tue	A	Using F-Speed film with XCP, expose the <b>LEFT</b> maxillary and mandibular
09/23	Wed	B	premolar and molar periapical views.
09/24	Thu	C	<i>Process and mount.</i>
09/25	Fri	D	Evaluate and obtain technician's signature for acceptable completion of lab assignment. Turn in first completed Full Mouth Survey (FMS) by 4:00PM.
09/29	Tue	A	<b>REVIEW</b>
09/30	Wed	B	"
10/01	Thu	C	"
10/02	Fri	D	"
<b>YOU WILL BE ASSIGNED A GRADE ON THIS SECOND FMS</b>			
10/06	Tue	A	Introduction to Electronic Patient Record (EPR).
10/07	Wed	B	Establish Pseudo-Patient file in EPR for digital radiology lab exercise
10/08	Thu	C	procedures.
10/09	Fri	D	Using Photostimulable Phosphor (PSP) Plates with XCP, expose the <b>RIGHT</b> and <b>LEFT</b> premolar and molar BW's.  <i>Mount and store in EPR.</i>

DATE	DAY	GROUP	PROCEDURE
10/13	Tue	A	Using PSP Plates with XCP, expose the <b>RIGHT</b> maxillary anterior and posterior periapical views, including the central incisor view.
10/14	Wed	B	
10/15	Thu	C	
10/16	Fri	D	
10/20	Tue	A	Using PSP Plates with XCP, expose the <b>RIGHT</b> mandibular anterior and posterior periapical views, including the central incisor view.
10/21	Wed	B	
10/22	Thu	C	
10/23	Fri	D	
10/27	Tue	A	Using PSP Plates with XCP, expose the <b>LEFT</b> maxillary anterior and posterior periapical views.
10/28	Wed	B	
10/29	Thu	C	
10/30	Fri	D	
11/03	Tue	A	Using PSP Plates with XCP, expose the <b>LEFT</b> mandibular anterior and posterior periapical views. <i>Mount and store in EPR.</i>
11/04	Wed	B	
11/05	Thu	C	Evaluate and obtain technician's signature for acceptable completion of lab assignment. Print and turn in second completed FMS by 4:00PM as prerequisite for taking the Final Practical Examination. <b>You will be graded on this FMS.</b>
11/06	Fri	D	
11/10	Tue	A	Using PSP Plates with Stabe® biteblocks, expose the <b>LEFT</b> maxillary and mandibular anterior periapical views.
11/11	Wed	B	
11/12	Thu	C	Using PSP Plates with BW tabs, expose the <b>LEFT</b> premolar and molar BW views. <i>Mount and store in EPR.</i>
11/13	Fri	D	
11/17	Tue	A	Using PSP Plates with Snap-A-Ray® holder and Stabe® biteblocks, expose the <b>LEFT</b> maxillary and mandibular premolar and molar periapical views.
11/18	Wed	B	
11/19	Thu	C	<i>Mount and store in EPR.</i>
11/20	Fri	D	
12/01	Tue	A	<b>REVIEW</b>
12/02	Wed	B	“
12/03	Thu	C	“
12/04	Fri	D	“

**LAB PRACTICAL EXAMINATION:** This examination will consist of exposing and mounting a partial FMS taken on a DXTR. This lab practical examination must be turned in no later than the end of the exam time period. Room and time assignments will NOT be assigned by original lab groups. Time assignment will be determined based on the time students finish the 2101/3101 written final exam on December 7, and beginning at 8:00 am on December 11. **ALL ASSIGNMENTS MUST BE COMPLETED AND TURNED IN PRIOR TO TAKING LAB PRACTICAL EXAMINATION.**

**CLINIC ATTIRE MUST BE WORN AS A MANDATORY REQUISITE FOR ATTENDANCE DURING ALL LAB SESSIONS AND DURING THE LAB PRACTICAL EXAMINATION.**

**YOU WILL NOT BE PERMITTED TO ATTEND THE LAB SESSIONS OR THE PRACTICAL EXAM WITHOUT PROPER CLINIC ATTIRE.**

## EVALUATION METHODS

### LECTURE

There will be two written examinations; two slide recognition examinations and a comprehensive final examination for this course. The material on the examinations will include all information pertinent to oral and maxillofacial radiology as covered in the lecture series and reference pages.

### LABORATORY

Students are expected to complete all lab exercises in order to obtain a final course grade. A total of up to a maximum of 12.5% will be deducted from the final lab grade for each late lab assignment.

Students must attend the lab period to which they have been assigned by the Office of Academic Affairs. If a student cannot attend an assigned lab period due to medical reasons, they may be able to switch a lab period with a consenting classmate. Such changes must be approved by the Lab Coordinator no later than twenty-four (24) hours prior to the scheduled lab.

### ATTENDANCE

**Attendance is mandatory** for all lectures and lab sessions. A student will be penalized for any lecture or lab session missed without an excused absence as determined by the Student Guide to Academic Studies. Students must also be on time. Late arrivals are disruptive. Consequently students arriving later than 10 minutes after the hour will be counted as absent (unexcused).

### GRADES

The course grade will be assigned according to the following criteria:

<b>LECTURE (75% of final grade)</b>		<b>LAB (25% of final grade)</b>	
Examination - Written	05%	Lab Slide Exam	15%
Examination - Written	10%	Lab Exercise (2 <sup>nd</sup> FMS)	25%
Examination - Slide	10%	Lab Practical Exam	50%
(Recognition of Normal Anatomy and Restorative Materials)		Attendance	10%
Examination - Slide	15%		
(Recognition of Faulty Images)			
Final comprehensive written exam	50%		
Attendance	10%		
<b>Total</b>	<b>100%</b>	<b>Total</b>	<b>100%</b>

Students must pass both the lecture and the lab components for successful completion of the course in order to perform patient radiographic procedures. Students with a failing grade in either component are required to remediate the specific component to attain a passing grade.