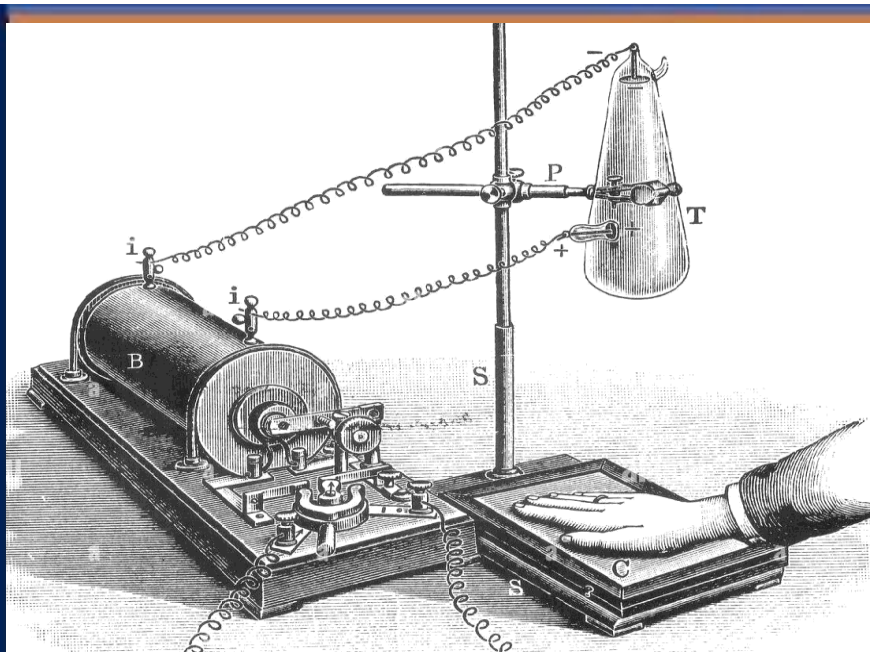
BMET 2320
Basic X-Ray



About Us

The College of Biomedical Equipment Technology (CBET) is a majority Veteran owned and operated private college offering Biomedical Equipment Technician (BMET), Healthcare Technology Management (HTM) and Healthcare Information Systems Management training at the certificate and associates degree levels. Our leadership team is comprised of individuals with decades of experience in the healthcare industry and education. Similarly, our instructional staff is comprised of industry experts and award-winning educators dedicated to providing quality education, training, and career services to our students.

Locations

Main Campus
105 Windy Meadows, Suites 201
Schertz, Texas 78154
www.cbet.edu

Mission

“The College of Biomedical Equipment Technology delivers premier education and training in Healthcare Technology Management and Information Technology to equip students to meet the evolving needs of the industries we serve.”

ABOUT THE COURSE

The Basic X-ray course is designed as an Interactive Distance Learning (IDL) course including asynchronous and synchronous live virtual instruction. The participant experience includes an introduction to the discovery of X-ray, adiation safety principles and protocols, anatomy as it pertains to X-ray imaging, primary and secondary X-ray circuits, physics of the X-ray tube, image capture technologies, image quality assurance, as well as communication and archiving technology. Students will participate in discussions on the material and equipment covered throughout the course and apply the materials covered in the course.

- Discovery of X-ray
- Safety standards
- Radiographic system functions
- Components of radiographicsystems
- Quality assurance methods and tools
- Basic troubleshooting and resolving common issues
- X-ray systems and modalities

COURSE DESCRIPTION

The Basic X-Ray course is designed to introduce students to radiographic instrumentation, the history of radiation, safety precautions, and the differences between the multiple modalities. The course will cover the major components, models, options, and costs associated with various radiographic systems, conducting preventative maintenance, and developing solutions for common user issues and equipment failure. Students will participate in discussions on the material and equipment covered throughout the course and explain the workings and functions of commonly used X-ray equipment in Healthcare Delivery Organizations (HDO), including Hospitals, Independent Service Organizations (ISO), Original Equipment Manufacturers (OEM), and other service providers.

LEARNING OBJECTIVES

LO1. Explore and understand the history of radiation and the specific precautions required to work with radiographic systems.
LO2. Explore and understand the anatomy and physiology specific to radiology and radiographic systems.
LO3. Explore and understand radiographic system functions and distinguish differences between the multiple modalities used in medical imaging.
LO4. Explore and understand the purpose of the major components utilized in the various radiographic systems and associated equipment systems.
LO5. Explore and understand the fundamentals of radiographic system preventative maintenance and quality assurance programs.
LO6. Compare and contrast various models, options, prices, and specialties involving radiographic systems from various manufactures.

TIME-ON-TASK

Time on task is the total learning time spent by a student in this course, including instructional time and time spent studying and completing course assignments and other activities (e.g., reading, research, writing, individual and group projects.) These activities are:

- Attending the weekly webinars
- Reading course presentations/ “lectures”
- Reviewing course notes
- Reading assignment references, books, or other course materials
- Participation in online discussions
- Conducting research
- Writing papers or other assignments
- Completing other assignments (e.g., projects)

The entire course Time-on-Task is 140 hours.

Instructor

The Basic X-ray course is led by a talented instructor via webinar and interactive distance learning formats. In addition to the weekly live sessions, instructor is accessible via the Learning Management System (LMS) daily, and by appointment via Zoom between the hours of Monday through Friday from 0800-1700 (CST).

Zachary (Zack) Nelson serves as an adjunct instructor for the College of Biomedical Equipment Technology and Imaging Academy. In his capacity as an adjunct instructor, Zack leverages his extensive experiences and in-depth knowledge of the HTM field. Prior to joining the college, Zack has worked over 25 years in various locations as an in-house BMET, Field Service Engineer (FSE), Lead BMET, and is currently the Director of Biomedical Engineering at a critical access hospital in Arizona. Throughout the course, Zack can be contacted directly via Canvas messaging or email at znelson@cbet.edu during office hours, Monday through Friday 0800 – 1700 CST.

Instructional Methods and Activities

The student online learning environment is structured to mirror the course syllabus and includes all the information students require to successfully navigate the course. The online learning environment referred to as CANVAS, provides a means for students to engage, communicate, and learn. CBET instructors will actively engage students in CANVAS via discussion board forums and other activities designed to cultivate student engagement and participation.

Online Classes (Daily): Students are expected to engage in CANVAS. Courses include weekly assignments, quizzes, tests, and other requirements prescribed by the instructor. Students are responsible for completing weekly assignments in a timely manner as prescribed by the instructor(s). It is important to remember that in addition to the resulting grades, completion of weekly assignments is also used to measure student engagement, attendance, and participation.

Weekly Live Webinars: Instructor-led webinars will be conducted at least once per week (60 Minutes). Additionally, students may request one-on-one counseling or tutoring sessions based on the instructor's availability. Webinars are not optional; however, we understand that from time-to-time students may not be able to attend in person. If you cannot attend a live session, the webinars will be posted in CANVAS for review.

Online Discussion Forum (Daily/Weekly): CANVAS includes a discussion board with weekly prompts and instructions for completing daily/weekly assignments. Students are required to respond to all weekly discussion board topics and instructor-directed prompts. Responses must be substantive and meet the minimum word count requirement. Additionally, students are required to engage with peers by responding to no fewer than two student responses per week. Student participation and attendance in CANVAS is reported to the Director of Education on a weekly basis and the information is used, in part, to measure attendance and participation in the course.

Late/Make-up work: All assignments must be completed on time and as instructed to receive full credit. Make- up work shall:

1. Be supervised by an instructor approved for the subject being made up.

2. Require the student to demonstrate the same knowledge or competence expected of a student who attended the scheduled class session.

3. No more than 5% of the missed work can be made up. All work must be completed and submitted within seven (7) calendar days of its original due date. All coursework must be submitted no later than six (6) calendar days after the course ends.

WEEK 1/MODULE 1 (Introduction to X-ray)

Learning Objective 1: Explore and understand the history of radiation and the specific precautions required to work with radiographic systems.	
TLO 1	Introduction to Imaging Sciences
TLO 2	Discovery of X-ray
TLO 3	X-ray equipment types
TLO 4	Radiation Protection, Dose Limits, Personal Protective Equipment, Engineering Controls, and ALARA

Module 1 Overview:

The first course module requires students to conduct a self-assessment to identify prior work experiences, education, and training that may be transferable to the Healthcare Technology Management Career Field. You will be asked to reflect on your prior skills and experiences to identify those that may be transferable to the HTM career field. Developing an understanding of your skills inventory and how previous experiences translate to HTM-related jobs is a critically important first step in creating a career ready resume.

Discussion Question (DQ) Introduction: Introduce yourself to the class by describing your:

1) Professional background
2) Where do you work currently?
3) Why are you interested in entering the Healthcare Technology Management (HTM) (Biomedical) career field?
4) If you are already in the HTM Industry, describe your career objectives related to this program.
5) How do you feel about X-rays?

[200-word minimum]

Webinar Session (60 Minutes): The Module 1 webinar will include a course overview and instructions to improve the student's ability to access materials and resources. Students will be asked to introduce themselves and will be expected to actively participate throughout the session. Following the introduction and class expectations, we will explore the discovery of X-ray, basic x-ray system types, and discuss radiation protection.

Module Summary: What did you learn this week? What did you find interesting? What improvement(s) could be made to this module? [250-word minimum]

SCORM Intro to Imaging Week 1: History of X-ray, Dangers of X-ray, Radiation Safety, Radiation Dose, ALARA, How are X-Rays Produced, Atoms, The Electromagnetic Spectrum and Radio Waves, Imaging Modalities, and a Knowledge Check.

Time-on-Task

The Time-on-Task for this module is 25.4 hours.

WEEK 2/MODULE 2 (X-Ray Circuit and Tube)

Learning Objective 1: Explore and understand the anatomy and physiology specific to radiology and radiographic systems.	
TLO 1	X-ray circuit components
TLO 2	Primary and Secondary Circuits
TLO 3	X-ray tube components
TLO 4	Filament and tube current
TLO 5	Induction Motor
TLO 6	Heat Units (HU)
TLO 7	Virtual Reality Lab – AMX 4 Battery Replacement

Module 2 Overview:

During week 2 students will develop an understanding and demonstrate their knowledge of: X-ray circuits and components, primary and secondary circuits, X-ray tube components, filament and tube current, induction motors, and heat units.

Discussion Question (DQ) Thinking Critically: Choose three of the Key Terms and explain their critical role in: (1) Maximizing X-ray production, (2) Extending the life of the X-ray tube, (3) Contributing to patient safety.

Key Terms:

1. Actual Focal Spot	7. Induction Motor
2. Effective Focal Spot	8. Protective Housing
3. Anode Heel Effect	9. Rotor/Stator
4. Filament	10. Thermionic Emission
5. Focusing Cup	
6. Heat Units	

[200-word minimum response due by Thursday 11:59 PM Central and at least two responses to your peers of 150-word minimum due by Sunday 11:59 PM Central]

Webinar Session (60 Minutes): Week 2 webinar will be exploring the X-ray system circuits, and components. We will discuss the primary and secondary circuits, X-ray tube components, filament and tube current, X-ray tube induction motor basics, and heat units (HU).

Module Summary: What did you learn this week? What did you find interesting? What improvement(s) could be made to this module? [250-word minimum]

SCORM Intro to Imaging Week 2: X-Ray Circuit, Generators and Components, X-Ray Tubes, Overview of a Radiographic System, Exposure Sequence, and Knowledge Check.

Virtual Reality Lab: AMX 4 Mobile X-Ray Unit Battery Replacement

Time-on-Task

The Time-on-Task for this module is 21.5 hours.

WEEK 3/MODULE 3 (X-Ray Image Production and Interactions)

Learning Objective 3: Explore and understand radiographic system functions and distinguish differences between the multiple modalities used in medical care.	
TLO 1	Photon Interactions: Characteristic vs Bremsstrahlung Radiation
TLO 2	Beam Quality and Quantity
TLO 3	X-ray interactions with matter (Scatter)
TLO 4	Introduction to Image Production
TLO 5	Differential Absorption
TLO 6	Image Capture
TLO 7	Introduction to Fluoroscopy

Module 3 Overview:

During module 3 students will develop an understanding and demonstrate their knowledge of: Characteristic and Bremsstrahlung radiation, X-ray beam quality and quantity, scatter radiation, image production, differential absorption, image capture, and an introduction to fluoroscopy.

Discussion Question (DQ) Thinking Critically: Provide your thoughts and opinions on at least two of the questions below:

1) During beam attenuation.
2) What occurs at the molecular level of anatomic tissues to affect the radiation exiting the patient?
3) Why is this something that must be considered by manufacturers
4) and radiographic technicians?
5) Explain why scatter radiation is detrimental. 3.Consider Radiographic and Fluoroscopicimaging,
6) Define the targeted purpose for each.
7) Explain how they differ from each other.

[200-word minimum response due by Thursday 11:59 PM Central and at least two responses to your peers of 150-word minimum due by Sunday 11:59 PM Central]

Webinar Session (60 Minutes): The module 3 webinar will emphasize Characteristic and Bremsstrahlung interactions, scatter radiation, differential absorption, and introductions to image production and fluoroscopy.

Module Summary: What did you learn this week? What did you find interesting? What improvement(s) could be made to this module? [250-word minimum]

SCORM Intro to Imaging Week 3: Bremsstrahlung Radiation, Heat Capacity, Beam Quantity and Quality, X-Ray Interactions with Matter, What do X-Rays Do?, Image Quality, and Knowledge Check

Time-on-Task

The Time-on-Task for this module is 19 hours.

WEEK 4/MODULE 4 (Image Quality and Exposure Technique)

Learning Objective 4: Explore and understand the purpose of the major components utilized in the various radiographic systems and associated equipment systems.	
TLO 1	Digital Detectors (Fixed vs Portable).
TLO 2	Image Quality
TLO 3	Exposure Index
TLO 4	Anti-Scatter Grids
TLO 5	Dose Area Product (DAP) Meters
TLO 6	Factors Affecting Image Quality
TLO 9	PACS and DICOM
TLO 10	MedRad Stellant Contrast Injector PM Procedure

Module 4 Overview:

During module 4 students will develop an understanding and demonstrate their knowledge of: Fixed and portable flat panel detectors, factors effecting image quality, exposure techniques and exposure index, anti-scatter grids, spatial resolution, resolution phantoms, penumbra effect, artifacts, as well as Digital Imaging and Communications in Medicine (DICOM) and Picture Archiving and Communication System (PACS).

Discussion Question (DQ) Thinking Critically: Provide your thoughts and opinions on at least two of the questions below:

1) Explain how the effects of quantum noise, scatter and artifacts affect the quality of the radiographic image
2) Explain how anatomic tissue composition affects beam attenuation and subsequently the radiographic contrast produced after processing
3) When using different digital detectors: (A) Explain what factors must be considered. (B) Explain the pros and cons of using each.

[200-word minimum response due by Thursday 11:59 PM Central and at least two responses to your peers of 150-word minimum due by Sunday 11:59 PM Central]

Webinar Session (60 Minutes): The module 4 webinar will include: digital flat panel detectors, image quality, exposure index, anti-scatter grids, spatial resolution, resolution phantoms, penumbra, artifacts, DICOM and PACS, and an introduction to the final project.

Module Summary: What did you learn this week? What did you find interesting? What improvement(s) could be made to this module? [250-word minimum]

SCORM Intro to Imaging Week 4: Image Quality and Characteristics, X-Ray Film, Computed Radiography (CR), Digital Radiography (DR), Primary Exposure Factors, IQ Factors, Unit 4 Quiz.

Virtual Reality Lab: MedRad Stellant Contrast Injector PM Procedure

Time-on-Task

The Time-on-Task for this module is 27.8 hours.

WEEK 5/MODULE 5 (Scatter Control, Automatic Exposure Control, Anatomical Programmed Radiography, and Quality Control)

Learning Objective 5: Explore and understand the fundamentals of radiographic system preventative maintenance and quality assurance programs.	
TLO 1	Radiation Safety - Dosimetry Monitoring
TLO 2	What is A Bucky
TLO 3	Automatic Exposure Control (AEC) and Ion Chambers
TLO 4	AEC and Proper Patient Positioning
TLO 6	Automatic (Anatomical) Programmed Radiography (APR)
TLO 7	Quality Management System
TLO 8	System Quality Testing
TLO 9	QA Tools

Module 5 Overview:

During module 5 students will develop an understanding and demonstrate their knowledge of: dosimetry monitoring devices, collimation and scatter mitigation, Bucky's, automatic exposure control (AEC), the importance of proper patient positioning and AEC, automatic (anatomical) programmed radiography (APR), review film and computed radiography (CR) image processing, and quality control.

Discussion Question (DQ) Thinking Critically: Provide your thoughts and opinions on at least two of the questions below:

1) Explain some of the advantages and disadvantages of beam restriction and how it compares to the use of an anti-scatter grid.
2) Explain why AEC is important for dose reduction and image quality. Explain the functions of APR.
3) Explain the importance of the BMET role in a QA program that supports the Radiology Department

[200-word minimum response due by Thursday 11:59 PM Central and at least two responses to your peers of 150-word minimum due by Sunday 11:59 PM Central]

Webinar Session (60 Minutes): The week 5 webinar will include: dosimetry monitoring, a review of collimation and scatter, introduction to the Bucky, Automatic exposure control (AEC), anatomical programmed radiography (APR), a review of film and computed radiography (CR) image processing, and quality control.

Module Summary: What did you learn this week? What did you find interesting? What improvement(s) could be made to this module? [250-word minimum]

SCORM Week 5: Beam Restriction, Automatic Exposure Control, The Evolution of Image Capture Technologies, and Unit 5 Quiz.

WEEK 6/MODULE 6 (Specialized Imaging Equipment)

Learning Objective 6: Compare and contrast various models, options, prices, and specialties involving radiographic systems from various manufactures.	
TLO 1	Fluoroscopy and Image Intensifiers
TLO 2	C-Arms
TLO 3	Interventional Radiography
TLO 4	Bone Densitometry
TLO 5	Mammography
TLO 6	Intraoral Radiography
TLO 7	Panographic Radiography
TLO 8	Panoramic Radiography and Cone Beam CT
TLO 9	Virtual Reality Lab: CT X-Ray Tube Exchange

Module 6 Overview:

Discussion Question (DQ) Thinking Critically: Provide your thoughts and opinions on at least two of the questions below:

1) Women's Health: Bone Densitometry and Mammography
2) Fluoroscopy and Interventional Radiography
3) Dental X-Ray Systems
4) Mobile X-Ray Systems

[200-word minimum response due by Thursday 11:59 PM Central and at least two responses to your peers of 150-word minimum due by Sunday 11:59 PM Central]

Webinar Session (60 Minutes): The week 6 webinar will cover fluoroscopy and image intensifiers, C-arms, interventional radiography systems, bone densitometry, mammography, computed tomography, and dental radiography.

Module Summary: What did you learn this week? What did you find interesting? What improvement(s) could be made to this module? [250-word minimum]

SCORM Intro to Imaging Week 6: Fluoroscopy, Interventional Radiography, Mammography, Computed Tomography, Magnetic Resonance Imaging, and Unit 6 Quiz.

Virtual Reality Lab: CT X-Ray Tube Exchange

Time-on-Task

The Time-on-Task for this module is 22 hours.

Note: Please remember to complete the end of course survey prior to the last day of class.

Course Grade Distribution

Discussion Board	25%
Module Summaries	25%
SCORM and VR Labs	25%
Final Exam	25%

Discussion Board Grading Criteria (25% of overall grade)

Students are required to respond to all weekly discussion board topics and instructor-directed prompts. Responses must be substantive and meet the minimum word count requirement. Additionally, students must engage with peers by responding to no fewer than two peer-to-peer responses per week. The following rubric is used as a guide by instructors to evaluate and grade student responses to discussion questions and peer-to-peer engagement:

	Beginning	Developing	Accomplished	Exemplary
	0-25 Points	25-50 Points	50-75 Points	75-100 Points
Weekly Discussion Question Responses (Minimum of two 200-word responses per week).	Contributes fewer than the required 2 Discussion Question (DQ) responses.	Contributes 2 Discussion Question (DQ) responses but one or both fail to meet minimum word-count requirements for the DQ.	Contributes by providing 2 Discussion Question (DQ) responses and meets the minimum word count requirements for the DQ.	Exceeds required DQ word count requirements and/or provides an exemplary response to a DQ.
Weekly Engagement with peers (Minimum of two 200-word responses to peers each week).	Contributes fewer than the required peer-to-peer responses in the discussion forum.	Contributes 2 peer-to-peer responses in the discussion forum but fails to meet minimum word-count requirements and lacks substance.	Contributes by providing 2 peer-to-peer responses and meets the minimum word count requirement for the peer-to-peer response.	Exceeds required peer-to-peer response requirements by meeting the minimum word count requirement and providing substantive responses to peers.
Quality and Content of DQ responses and peer-to-peer responses in the Discussion Forum.	Postings in the discussion forum are not relevant to the assigned topic, are inaccurate, or misrepresented.	Postings in the discussion forum address peripheral topics, are generally accurate, but may contain factual omissions and/or errors.	Postings are generally substantive; however, responses rely too heavily on opinion than fact. Postings meet word count requirements but lack scholarly tone or appropriate references.	Discussion Question and Peer-to-Peer postings consistently contribute to the discussion, contain substantive comments backed by relevant references and encourage open dialogue and additional discussion in the class.

Weekly Live Webinars

Instructor-led webinars will be conducted at least once per week (60 Minutes). Webinars are not optional; however, we understand that from time-to-time students may not be able to attend in person. If you cannot

attend a live session, the webinars will be posted in CANVAS for review. Instructors will assign weekly assignments associated with the live webinars.

SCORM and VR Labs (25%)

Students will be assigned homework on a weekly basis. Homework may consist of a wide variety of deliverables. Quizzes are assigned in weeks one, two, and five. Homework may include a wide array of requirements, ranging from written assignments, research projects, Power- Point presentations, and a host of other activities. In all cases, instructors will endeavor to ensure that students possess a clear understanding of the requirements and expectations.

Final Exam (25%)

The course includes a final exam in week six. The exam format includes multiple choice, true or false questions, diagrams, and matching.

Grading System for the College of Biomedical Equipment Technology

A	90-100	4.0	F	59 & Below	0.0
B	80-89	3.0	W	Withdrawal	N/A
C	70-79	2.0	I	Incomplete	N/A
D	60-69	1.0	T	Transfer	N/A

To receive an incomplete "I", the student must petition the instructor for an extension to complete the required coursework. The student must be able to pass the course with the completed work and garner a grade of 70 or better. Incomplete grades that are not completed within 7 business days after the beginning of the next session will be converted to the existing grade earned in the course and will affect the student's GPA accordingly. CBET reserves the right to extend the time needed to fulfill the incomplete.

An "I" does not count towards the Grade Point Average (GPA) until a grade is assigned. A "W" is given when a student is dropped from the roster during the course and does not replace the previous grade(s). Grades of "W" and "F" are recorded in the academic transcript and reflected in the GPA. When a course is repeated after failure or withdrawal, the later grade will replace the first grade in calculating the CGPA. The clock hours of the course repetition are counted toward the maximum timeframe. CBET shall record a grade of "incomplete" for a student who withdraws but is not entitled to a refund if the student requests the grade at the time the student withdraws, and the student withdraws for an appropriate reason unrelated to the student's academic status.

A student must repeat a course in which a grade of "F" was received. A student can repeat each course once, however, once they reach 1.5 times the length of time required for graduation, they will be dropped from the program. If a student fails any course a second time, he/she will be dropped from the program. A failed course will be rescheduled for the earliest possible module at the discretion of the Director of Education. Students will be charged to retake the course.

Additional Resources and Points of Contact

Students requiring additional administrative support are encouraged to contact the College's Student Advocate, Mrs. Terri Gomez, at 210.233.1102 or via e-mail at tgomez@cbet.edu

For a complete list of administrative policies and regulations refer to the CBET Catalog at https://cbet.edu/course-catalog