



BMET 2304 Biomedical Equipment 1

About Us

The College of Biomedical Equipment Technology and Imaging Academy represents a joint venture designed to meet the education, training, and professional development needs of Healthcare Technology Management professionals. Our headquarters is in San Antonio, Texas, adjacent to Fort Sam Houston, the military's home for biomedical equipment technician training.

Location

College of Biomedical Equipment Technology
105 Windy Meadows, Suites 201 & 202 | Schertz | Texas 78154
www.cbet.edu

Mission

"The mission of the College is to provide innovative and relevant Healthcare Technology Management, Compliance, and Imaging education, training, and career services to prepare our students to meet the evolving needs of employers in the healthcare industry."

ABOUT THE COURSE

Electronics I is the first of a series of three courses devoted to teaching the basics of electrical theory, functions of electronic circuits, and practical applications for those circuits in the control of medical devices.

- Patient Safety
- Test Equipment
- Infection Control
- Roles and Responsibilities
- Personal Safety Measures and Precautions
- Medical Equipment Operation

COURSE DESCRIPTION

The course is a 6-week course designed to introduce the hierarchy of statutes, regulations, standards, including accreditation standards and hospital policies for healthcare equipment management and safety. The course focuses on performing extensive equipment testing to verify conformity with national standards and manufacturer's specifications; and learn standard practices for electrical safety testing, HTM, and medical ethics. Also, the course introduces the equipment management principles that maximize the life span and minimize life-cycle costs as a BMET employs and troubleshoots facility equipment while emphasizing resource and chemical use management.

LEARNING OBJECTIVES

- LO1. Identify basic medical test equipment, such as electrical safety test equipment, and be able to perform these tests.
- LO2. Describe many of the most used pieces of medical equipment in various healthcare settings, such as their names and functions.
- LO3. Explain the most common failures and resolutions to the medical equipment covered in the course.
- LO4. Discuss various manufacturers, prices, and model types of equipment covered in the course.
- LO5. Operate the resources provided in this course to research and find information about any piece of medical equipment.

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 for this course is 122 hours.

Instructional Team

The Biomedical Equipment I is led by instructors via webinar and interactive distance learning formats. In addition to the weekly live sessions, instructors are accessible via the Learning Management System (LMS) daily, and by appointment via Zoom between the hours of Monday through Friday from 1700-2100 (CST).



Mr. Langmeyer works as an Enterprise Account Manager for PartsSource, Inc. and has over 18 years of experience in the field of Healthcare Technology. He served 5 years in the U.S. Army where he received training as a Biomedical Equipment Technician. Upon separation from the service, Chris worked as a technician performing field service in addition to hospital-based maintenance. He worked his way into leadership and ran hospital based Biomedical Engineering programs for both small and large health systems. Chris holds both a Bachelor and Master of

Science in Quality Systems Management. Additionally, he maintains certifications as a Certified Biomedical Equipment Technician (CBET), Certified Healthcare Technology Manager (CHTM), and Lean Six Sigma Black Belt (LSSBB).

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 includes 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 Mandatory: Mandatory 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.

Virtual Reality Modules: Virtual Reality (VR) assignments are incorporated into several of the modules for those who have the capability. For students without VR capability, an alternate e-learning assignment ensures equal access to the course material.

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 Medical Equipment

Learning Objective 1: Describe many of the most used pieces of medical equipment in various healthcare settings, such as their names and functions.

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| TLO 1 | Identify clinical applications for basic medical equipment. |
| TLO 2 | Understand Infusion pump functions and most common failures. |
| TLO 3 | Evaluate Biomedical Equipment Technician job descriptions and compare/discuss the similarities/differences of each. |

Module 1 Overview:

During week 1 module, students will demonstrate and apply knowledge of pursuing BMET as a career, BMET's roles and responsibilities, and medical equipment. Students will be able to construct and deconstruct models of the readings and equipment covered and understand the workings and inner workings of each.

Week 1 Discussion Questions

- Must answer the required questions and respond to 2 classmates to receive full credit, no minimum word count.
- Discussion Question (DQ) 1: Introduce yourself to the class by describing your (1) what your hobbies are, (2) where you work currently, and (3) why you are interested in entering the Healthcare Technology Management (HTM) (Biomedical) career field. If you are already in the HTM Industry, describe your career objectives related to this program.
- Discussion Question (DQ) 2: Equipment - Automated Lab Analyzer, Anesthesia Units, Apnea Monitors, Aspirators, Auditory Function Screening Devices, Bilirubinometers, Blood gas/Chemistry Analyzers, Blood pressure monitors (Non- invasive).

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. During the first week, participants will be encouraged to reflect on their own experiences and skills. Instructional focus will be oriented towards introduction to course and expectations. Webinar summary will need to be completed to receive full credit, regardless of attendance during the live webinar.

Week 1 Assignments

- Assignment 1: Reading: Chapter 1 (pp. 1-14) Answer questions 1-9 on pp. 14-15.
- Assignment 2: Video quiz - Infusion Pumps.
- Assignment 3: Virtual Reality Lab – Alaris IV Pump Output

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

WEEK 2/MODULE 2 - Electrical Safety

Learning Objective 2: Identify basic medical test equipment, such as electrical safety equipment, and be able to perform these tests.

- TLO 1 Identify and understand the use of different types of test equipment
- TLO 2 Analyze different jobs for BMETs
- TLO 3 Discuss professional certification available for BMETs through AAMI

Module 2 Overview:

During module 2 students will demonstrate and apply their knowledge of Patient Safety, Electrical Safety Testing Equipment, and medical equipment. Students will be able to construct and deconstruct models of the readings and equipment covered and explain the workings and inner workings of each.

Week 2 Discussion Questions

Must answer the required questions and respond to 2 classmates to receive full credit, no minimum word count.

- Discussion Question (DQ) 1: Equipment (Electrical Safety Testing Equipment, Ophthalmoscopes, Bronchoscopes, Cataract extraction units, Clinical Chemistry Analyzers, Colonoscopes, Cryosurgical units, cytometers, defibrillators)
- Discussion Question (DQ) 2: Electrical Safety Testing: discuss (1) Why do you think electrical safety testing is so important? (2) What are the risks of not performing an electrical safety test on any piece of medical equipment? (3) What about allowing a failing piece of equipment or faulty power cord to remain on the floor as active equipment?

Webinar Session (60 Minutes): The week 2 webinar will be a discussion including week one review. This includes what is a BMET?, BMET roles and responsibilities, certifications, and AAMI. Week two topics that are covered include Patient safety, electrical safety, and test equipment. Webinar summary will need to be completed to receive full credit, regardless of attendance during the live webinar.

Week 2 Assignments

- Assignment 1: Reading: Chapter 2 (pp. 19-36) Answer questions 1-5 & 7-9 on pp. 36-37.
- Assignment 2: Video Quiz - Electrical Safety Test.
- Assignment 3: Watch extra info videos- Planned preventive maintenance, Electrical Safety Testing FAQs, NFPA 99 Electrical Safety, BioMed's prospective, Various Types of Electrical Safety Analyzers.

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

WEEK 3/MODULE 3 - BMET Customer Service

Learning Objective 3: Explain the most common failures and resolutions to the medical equipment covered in the course.

- TLO 1 Understand the importance of building relationships with internal and external customers.
- TLO 2 Identify the importance of personal safety.
- TLO 3 Explore the issues that could arise due to lack of relationships and communication with your customers.
- TLO 4 Discuss and understand common failures/issues that could arise caused by users and some resolutions to these common problems.

Module 3 Overview:

During module 3 students will participate in a webinar discussion highlighting the importance of personal safety and customer service. Students will also identify the importance of maintaining professional communications with staff and patients, to include through email and voice interactions.

Week 3 Discussion Questions

Must answer the required questions and respond to 2 classmates to receive full credit, no minimum word count.

- Discussion Question (DQ) 1: Equipment - Bone densitometer, electrocardiograph, ultrasonic fetal heart detector, fetal monitor, glucose analyzer, hematology analyzer, hemodialysis unit.
- Discussion Question (DQ) 2: BMET Customer Service- (1) Explain some ways a BMET might generate good rapport with the clinicians/nurses/doctors/techs, etc. that they work with daily. (2) Discuss the pros/cons of having good rapport, bad rapport, or no contact with the hospital staff and what implications this could have. (3) Add any information you feel will enhance the discussion

Webinar Session (60 Minutes): The module 3 webinar will emphasize the importance of protecting their personal safety and having good customer service. Elaborating on what to do and what not to do when it comes to personal safety and establishing good customer service. Included in the discussion is what common failures/issues that arise when proper relationships are not built. Webinar summary will need to be completed to receive full credit, regardless of attendance during the live webinar.

Week 3 Assignments

- Assignment 1: Reading: Chapter 3 (pp. 39-50) Answer questions 1-7 on pp. 50-51.
- Assignment 2: Video Quiz- Ophthalmoscope.
- Assignment 3: Watch extra info videos: Principles of Medical Equipment and BMETs & Customer Service.

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

WEEK 4/MODULE 4 - Clinical Engineering Role in Patient Flow and Safety

Learning Objective 4: Discuss various manufacturers, prices, and model types of equipment covered in the course.

- TLO 1 Explore the clinical engineer's role in patient flow and safety
- TLO 2 Understand the lifecycle of medical equipment
- TLO 3 Evaluate medical equipment and information associated with different types

Module 4 Overview:

During module 4 students will learn about the BMET's role in patient flow and safety. Students will be expected to understand the life cycle of equipment and what happens in each step. Students will receive more information on other medical equipment items that include topics such as, health problem addressed, product description, principles of operation, operating steps, reported problems, use and maintenance, environment of use, and product specification. All information adds to what was learned in previous modules.

Week 4 Discussion Questions

Must answer the required questions and respond to 2 classmates to receive full credit, no minimum word count.

- Discussion Question (DQ) 1: Equipment - Immunoassay analyzer, Infant incubator, CO2 Laser, Ophthalmic Laser, Mammography unit, electroencephalography bedside monitor, central station monitor, physiologic monitoring system.
- Discussion Question (DQ) 2: Patient Flow and Safety- Watch the video in the hyperlink and answer the following question (1) Develop an answer to the question, "As a BMET what our role in patient flow and safety is?" (2) Be sure to explain whether you believe BMETs have a role/responsibility in patient flow and safety or not.

Webinar Session (60 Minutes): The module 4 webinar will include a discussion on the BMET's role for patient flow and patient safety. Identify different types of thermometers and warming/cooling units. Discussion also includes elaboration on the many different types of manufactures, price ranges, and models available for like equipment as well as different types of equipment. The webinar also explains the life cycle of medical equipment. Webinar summary will need to be completed to receive full credit, regardless of attendance during the live webinar.

Week 4 Assignments

- Assignment 1: Reading: Download booklet using link- Rigel 288 Electrical Safety Analyzer- Answer 4 questions (1) What is a macro shock? (2) What is a protective ground? (3) What is acceptance testing? (4) Explain the outcome of a macro shock on the human body using the parameters below: (a) with a frequency of 50/60 hz (b) with a connection to the skin for approximately 1-3 seconds (non-invasive) (c) with a current of 10-100 mA.
- Assignment 2: Video quiz - How Analog & Digital Thermometers work.
- Assignment 3: Video quiz - Suction Devices.
- Assignment 4: Virtual Reality Lab – Portable Suction Regulator PM

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

WEEK 5/MODULE 5 (Defibrillators/Scales)

Learning Objective 5: Explain the most common failures and resolutions to the medical equipment covered in the course.

TLO 1 Evaluate medical equipment and information associated with different types.

TLO 2 Explore medical equipment to complete research for final project.

TLO 3 Clinical applications for Defibrillators and Scales.

Module 5 Overview: During module 5 students will learn more medical equipment items. Students will get a deep dive on defibrillators and scales. Students will begin their preparation for their final research project with provided guidance.

Week 5 Discussion Questions

Must answer the required questions and respond to 2 classmates to receive full credit, no minimum word count.

- Discussion Question (DQ) 1: Equipment (Physiologic telemetric monitor, Peritoneal Dialysis Unit, Pulmonary function analyzer, Radiographic fluoroscopic system, Radiotherapy planning system, radiotherapy systems, remote-after loading brachytherapy system, scanning system, CT).
- Discussion Question (DQ) 2: Best practices & testing of electrosurgical units (ESUs)- Watch the video in the hyperlink and answer the following question (1) Develop an answer to the question, "What were 3 key points or topics discussed in video that you found interesting?" (2) Be sure to explain which key point you feel is most important and why you believe it to be.

Webinar Session (60 Minutes): During Week-5 students engage in discussions emphasizing the importance of defibrillators and scales. In addition, students are provided information for their final project. In preparation they are instructed to find a piece of equipment to use to complete their final project during week 5. Guidelines are provided and discussed during the webinar session. Webinar summary will need to be completed to receive full credit, regardless of attendance during the live webinar.

Week 5 Assignments

- Assignment 1: Reading assignment - Download booklet using link- Rigel Vital signs booklet USA- Answer 4 questions (1) A pulse oximeter testers' accuracy should not exceed what percent? (2) ECG leads are color-coded. How many different sets of color codes are there and what is the title of each set? (3) When testing pressure, what is the difference between static and dynamic tests? (4) Planned preventive maintenance is an important aspect during the useful life of a medical electronic device. To ensure safety of the patient and operator, what procedures are required and need to be covered?
- Assignment 2: Video quiz - Patient Monitor.
- Assignment 3: Video quiz - Scales.
- Assignment 4: Extra info - AEDs - Testing & Important info, Electrosurgical Units - Best practices & testing.
- Assignment 5: Virtual Reality Lab – Suction Regulators

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

WEEK 6/MODULE 6 (Final Project)

Learning Objective 6: Operate the resources provided in this course to research and find information about any piece of medical equipment.

- TLO 1 Evaluate medical equipment and information associated with different types.
- TLO 2 Demonstrate ability to research medical equipment and provide information to purchase new equipment.
- TLO 3 Operate the resources provided in this course to research and find information about any piece of medical equipment.

Module 6 Overview: During module 6 students will study more types of medical equipment through their weekly discussion. Students will complete their final research product on their equipment of choice. During this research project students will research common failures and resolutions, various manufacturers, prices, and models of the same type of equipment. Students will use everything they learned during this course to complete their final project.

Week 6 Discussion Questions

Must answer the required questions and respond to 2 classmates to receive full credit, no minimum word count.

- Discussion Question (DQ) 1: Equipment (MRI full-body scanning system, Ultrasonic scanning system, Transcutaneous blood gas monitor, Intensive care ventilator, Intensive care Neonatal/pediatric ventilator, Portable ventilator, Telemedicine videoconferencing system, radiant infant warming unit, whole blood coagulation analyzer)

Webinar Session (60 Minutes): During Week-6 students will have the opportunity to have a question-and-answer session specific to the final project. Webinar is optional and does not count toward final grade.

Week 6 Assignments

- Assignment 1: Final project - (1) Pick a piece of medical equipment that has not been covered in any of the readings, quizzes, videos of this course. (2) Research: (a) Service Manual/Operator's manual (b) Preventive Maintenance (PM) procedure (c) List test equipment and interface devices required to perform PM (d) Submit (3) Answer following questions (a) What is the unit's primary function? (b) What area or department would this device likely be located/utilized? (c) If possible, name some manufacturers of similar units and their makes/models. (c) Estimated list price cost of your selected item. (d) Pricing of the required test equipment (e) Common failures of the equipment (f) Anything you think is interesting or relevant about the equipment you find when doing research.
- Assignment 2: Extra info: Fundamentals of pulse oximetry, Intro to contrast injector operation & service, radiant warmer testing best practices.

The Time-on-Task for this module is 21 hours.

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

Course Grade Distribution

- Discussion Board 30%
- Weekly Live Webinars 30%
- Homework Assignments 30%
- Final Exam 10%

Discussion Board Grading Criteria (30% of overall grade)

Students are required to respond to all weekly discussion board topics and instructor-directed prompts. Students 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 (30% of overall grade)

Mandatory 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.

Weekly Quizzes (30%)

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. Worksheets are assigned in weeks two and four. Homework may include a wide array of requirements, ranging from written assignments, research projects, PowerPoint 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.

Exams (10%)

The course includes a midterm exam in week three and a final exam in week six. The exam format includes multiple choice, true or false questions, diagrams, and matching. An exam review will be conducted during the live webinar on weeks three and six.

Grading System for the College of Biomedical Equipment Technology

Grade	Range	Points	Grade	Range	Points
A	90-100	4	F	0-59	0
B	80-89	3	W	Withdraw	n/a
C	70-79	2	I	Incomplete	n/a
D	60-69	1	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 Colleges 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>