



BMET 2301 Troubleshooting Theory and Methodology



About Us

The College of Biomedical Equipment Technology and Imaging Academy represent 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

Main Campus

11550 IH 10 W, Suite 190
San Antonio, Texas 78230

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

The Troubleshooting Theory & Methodology course is designed as an Interactive Distance Learning (IDL) course including asynchronous and synchronous live virtual instruction, and virtual reality (VR) labs. The participant experience includes a self-assessment of skills and knowledge, an exploration of the HTM career field, and the development of a career ready resume.

- Skills & Knowledge Self-Assessment
- Career Field Exploration
- Problem Solving Model
- Troubleshooting Techniques

COURSE DESCRIPTION

Troubleshooting Theory and Methodology is a 6-week course designed to introduce students to the basic concepts and theories of troubleshooting. The course focuses on troubleshooting methodologies that identify a problem and employing manageable, practical steps to correct the problem. These steps include identifying the problem, determining the probable cause, testing cause-hypothesis, creating a feasible solution, implementing, and verifying the resolution, and adjusting for reengagement. Just as important, the BMET then records the solution through quality documentation of actions, outcomes, and lessons learned. These skills will be taught and reinforced using guided discussions, case studies, and lessons learned from experiences in the BMET field from the instructor and fellow students.

LEARNING OBJECTIVES

LO1 Review Electronic Basics, Schematic Symbols, basic Troubleshooting terms and Tool

LO2 Predict expected circuit outputs in relation to a circuit's measured inputs, as well as fault identification

LO3 Identify various troubleshooting techniques and applications, as well as Sterilization Principles

LO4 Discuss the importance of medical equipment test devices, the maintenance of said equipment, and governing regulations, as well as risk management

LO5 Students will develop a deeper understanding of the importance of blending information technology with medical equipment.

LO6 Participate in a group discussion on what the students expect in the HTM world and provide professional insight to further their knowledge of the career field.

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 117 hours.

Instructional Team

The Troubleshooting 2301 course 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 0800-1700 (CST).



Wes started as an electronics technician before finding a career in the Biomed field. During his seventeen-year tenure he had the opportunity to work on general biomedical equipment as well as anesthesia machines, patient monitoring systems, nurse call systems, phone and voicemail systems, infant abduction, security, building automation, and anything else that may have come my way. During this time, he held many positions such as Biomed Technician, Biomed Supervisor, and General Manager of Facilities. Five years ago, Professor Wes transitioned to an IT position working as an interface integration engineer connecting patient monitoring systems to the Electronic Medical Record (EMR). I have many hobbies and interests that involve building, woodworking, tinkering, audio and electronics, and actively acting as a level 2 NICA coach. His CBET certification is still current, and additionally I volunteer as a board member with the Kentucky Association of Medical Instrumentation (KAMI). 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.

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: 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. Also, students must engage with peers by responding to at least two student responses per week. Student participation and attendance in CANVAS is reported to the Director of Education weekly, and the information is used 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 (Getting Started)

Learning Objective 1: Review Electronic Basics, Schematic Symbols, basic Troubleshooting terms and Tool	
TLO 1	Identify power production from origin source to outlet, and where BMET takes responsibility
TLO 2	Identify importance of battery maintenance and disposal Procedures
TLO 3	Basic power troubleshooting with a Digital Multi-Meter
TLO 4	Overview of the 7 Step Troubleshooting Methodology

Module 1 Overview:

The first course module requires students to review basic Power production, provide any background talents/skills that would benefit them in the BMET career field, and builds the foundational knowledge of basic troubleshooting, to include a 7 Step guide on how to begin their troubleshooting journey.

Week 1 Discussion Questions

Discussion Question (DQ) 1: Welcome and Introductions: Introduce yourself to the class by describing what influenced you to become a member of the BMET world (2) What industry do you currently work in (3) What experience do you have in troubleshooting?

Discussion Question (DQ) 2: Rules of Repair Video: From the video, (1) Which 2 of the 8 rules discussed would you consider the most important and why? (2) Is there a troubleshooting rule you utilize that is not mentioned in the video, and if so, what is it? [Minimum 200-word response]

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 provided reading material prior to the webinar, which they will be expected to discuss in an open forum during the webinar with facilitation by the Course Professor. The webinar will include an overview of steps 3 and 4 of the Troubleshooting Methodology, power generation methods, utilizing a Digital Multi-Meter (DMM) to trouble shoot basic power supply/circuits, power supply nomenclature and denotations, and Isolation transformers.

Week 1 Assignments

Assignment 1: Why is my Medical Equipment Failing - Students will be required to read this assignment prior to the webinar, where they will be involved in a 10-to-15-minute discussion on the assignment where they will be asked questions on the material, as well as open discussion about any experience they may have encountered with matters pertaining to the literature.

Assignment 2: Troubleshooting: Students will be provided an equipment modality, as well as a scenario, and will be required to troubleshoot the issue with the troubleshooting methodology steps covered up to that point during the webinars.

Assignment 3: Webinar Summary: Students will be required to provide a webinar summary of the material covered during the week's webinar.

Assignment 4: Quiz: students will take a quiz based on the material covered during the webinar, the reading assignment and the source material for the discussion question.

Time-on-Task: The Time-on-Task for this module is 16 hours.

WEEK 2/MODULE 2 (Steps 3 - 4)

Learning Objective 2: Predict expected circuit outputs in relation to a circuit's measured inputs, as well as fault identification.

TLO 1	Understand the basics of Ohms Law
TLO 2	Identify the difference between expected and measured voltages in an Open and a Short
TLO 3	Identify basics about Transistors and IC Chips
TLO 4	Identify Steps 3 and 4 of the Troubleshooting Methodology

Module 2 Overview:

Students will be taught about a basic electronics principle, Ohm's Law, as well as how to identify the difference between an open and a short, where they will be asked what the expected voltages at certain points on the circuit will be. An overview of 2 common electronics will be provided as well as a further dive into the troubleshooting methodology.

Week 2 Discussion Questions

Discussion Question (DQ) 1: Students will identify an item in their life that did not function properly until a qualified service member is asked to investigate the item. They will then share said tale with fellow students. [Minimum 200-word response for full credit]

Webinar Session (60 Minutes): During week 2 Webinar, students will discuss the reading assignment and an overview of steps 3 and 4 of the Troubleshooting Methodology. Students will also learn about Block Diagrams, Interconnect Diagrams, basic electronic component identification, schematic power denotations, basic soldering and desoldering techniques and troubleshooting.

Assignment 1: Reading Assignment - Students will be required to review a reading assignment on a BMETs involvement in the equipment investigation process. This will be discussed during the webinar.

Assignment 2: Troubleshooting – VR - Hill-Rom Advanta 2 Patient Power Cord Failure: Perform an electrical safety test on a Hill Rom patient bed using a BC Group SA-2005 safety analyzer. Determine that the power cord is faulty and replace it.

Assignment 3: Webinar Summary - Students will be required to provide a webinar summary of the material covered during the week's webinar.

Assignment 4: Quiz - students will take a quiz based on the material covered during the webinar, the reading assignment as well as the source material for the discussion question.

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

WEEK 3/MODULE 3 (Troubleshooting Techniques / Steps 5 - 6)

Learning Objective 3: Identify troubleshooting techniques and applications and Sterilization Principles.

TLO 1	Identify Troubleshooting Techniques, how they apply and when to use them.
TLO 2	Identify basic principles of Solenoids, Steam and Pressure.
TLO 3	Soldering and Desoldering techniques and troubleshooting
TLO 4	Develop understanding of Steps 5 and 6 of the Troubleshooting Methodology

Module 3 Overview:

During module 3 students will be introduced to various troubleshooting techniques, of which 4 will be further explained, as they are the ones that pertain to being a BMET the most. Students will also learn about solenoids and magnetism, and how these two ideas are crucial in the operation of Sterilizers. Finally, students will be provided with steps 5 and 6 of the Troubleshooting Methodology.

Week 3 Discussion Questions

Discussion Question (DQ) 1: Students will watch the provided video, and deliberate whether they do or do not agree with the 3 rules established by the video. (2) Students are asked if there is a rule that they always follow while problem solving. (3) Students are asked to explain if they have been a victim of someone's poor troubleshooting. [Minimum 200-word response for full credit]

Webinar Session (60 Minutes): The module 3 webinar will include an overview of steps 5 and 6 of the Troubleshooting Methodology, additional troubleshooting methods, solenoids, steam, basic sterilizer overview, and troubleshooting charts.

Week 3 Assignments

Assignment 1: Students will be required to review a reading assignment on a BMETs involvement in the equipment investigation process. This will be discussed during the webinar.

Assignment 2: Troubleshooting – VR - GE Mac 5500 ECG Lead Failure: Determine if a lead or acquisition box is faulty on a Mac 5500 ECG machine using the Fluke Prosim 8 patient simulator.

Assignment 3: Students will be required to provide a webinar summary of the material covered during the week's webinar.

Assignment 4: Students will take a quiz based on the material covered during the webinar, the reading assignment as well as the source material for the discussion question.

Time-on-Task: The Time-on-Task for this module is 17 hours.

WEEK 4/MODULE 4 (Test Equipment / Risk Management)

Learning Objective 4: Discuss the importance of medical equipment test devices, the maintenance of said equipment, and governing regulations, as well as risk management.

TLO 1	Provide an overview of different manufacturers of test equipment.
TLO 2	Discuss the importance of maintaining test equipment and who is responsible for said maintenance.
TLO 3	Review governing regulations on the maintenance of test equipment.
TLO 4	Discuss risk management and its application in the HTM world.
TLO 5	Develop understanding of Step 7 of the Troubleshooting Methodology

Module 4 Overview:

During module 4 students will develop an understanding of the importance of proper test equipment maintenance as well as the governing regulations that guide the HTM community in maintenance of test equipment. Students will also be engrossed in discussion surrounding risk management and the different approaches an HTM professional can take in applying proper risk management.

Week 4 Discussion Questions

Discussion Question (DQ) 1: (1) Students will review an article on approaching risk management and making calculated risks, (2) then provide self-reflection on their own ability to balance emotional vs logical risk. (3) They will finally be required to further reflect on their own risk management talents. [Minimum 200-word response for full credit]

Webinar Session (60 Minutes): The module 4 webinar will include a broad discussion of test equipment, maintenance of the test equipment as well as governing bodies and articles, an article covering a BMET shops approach to risk management which will develop into a discussion of what the students believe to be proper risk management, followed by the 7th and final step to the troubleshooting methodology. The webinar will be concluded with an overview of what is expected of them for the rough draft of their final projects, to include a breakdown of the essay and the presentation.

Week 4 Assignments

Assignment 1: Reading assignment - Students will be required to review a reading assignment on a BMETs involvement in the equipment investigation process. This will be discussed during the webinar.

Assignment 2: Webinar Summary - Students will be required to provide a webinar summary of the material covered during the week's webinar.

Assignment 3: Quiz - students will take a quiz based on the material covered during the webinar, the reading assignment as well as the source material for the discussion question.

Assignment 4: Final Project Draft - students will develop a rough draft for their final project. The final project consists of an APA format essay as well as a power point presentation based on a piece of equipment that the students researched, identifying 3 simple user correctable issues to develop user training for.

Time-on-Task: The Time-on-Task for this module is 23 hours.

WEEK 5/MODULE 5 (Medical IT)

Learning Objective 5: Students will develop a deeper understanding of the importance of blending information technology with medical equipment.

TLO 1	Develop an understanding of PII, PHI and why these are important to an HTM professional.
TLO 2	Identify Common IT terms and components necessary for a computer to function.
TLO 3	Identify basic IT troubleshooting techniques and maintenance.
TLO 4	Develop an understanding of the different Computer based medical equipment management systems (CMMS).

Module 5 Overview:

During module 5 will learn about the importance that IT equipment plays in the HTM world, developing an understanding of the different components involved in making a computer operate successfully, identifying maintenance techniques and troubleshooting methods for a computer based medical device, and finally different computer-based management systems available to an HTM professional.

Week 5 Discussion Questions

Discussion Question (DQ) 1: Students will compare 2 different types of sterilization, providing 3 pros and 3 cons of each, then identifying which one they would recommend most and why. [Minimum 200-word response for full credit]

Webinar Session (60 Minutes): During Week-5 students engage in discussions surrounding the world of medical IT, to include PHI and PII, several computer components, maintenance and troubleshooting of IT equipment, network cables, testing devices, as well different models of CMMS that are available to them.

Week 5 Assignments

Assignment 1: Reading assignment - Students will be required to review a reading assignment on a BMETs involvement in the equipment investigation process. This will be discussed during the webinar.

Assignment 2: Webinar Summary - Students will be required to provide a webinar summary of the material covered during the week's webinar.

Assignment 3: Final Project Draft - second draft: student's will further develop their rough draft for their final project. The final project consists of an APA format essay as well as a power point presentation based on a piece of equipment that the students researched, identifying 3 simple user correctable issues to develop user training for.

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

WEEK 6/MODULE 6 (Medical IT)

Learning Objective 6: Participate in a group discussion on what the students expect in the HTM world, and provide professional insight to further their knowledge of the career field.

TLO 1	Identify the impact of IT on the point of care
TLO 2	Field group discussion on the HTM world, facilitated by the course professor

Module 6 Overview:

During module 6 students will discuss the reading assignment on the impact of IT on the patient's point of care and then engage in a discussion on how computers have changed the way an HTM professional operates. The course professor will then provide the students with any insight, supported by the students in the course who already have experience in the HTM world.

Webinar Session (60 Minutes): In the week 6 webinar, students will hold a group discussion on how medical computers have impacted patient point of care and the HTM world. The course instructor will provide any final insights to the students and field any questions they may have to further their knowledge of the HTM world.

Week 6 Assignments

Assignment 1: Reading assignment - Students will be required to review a reading assignment on a BMETs involvement in the equipment investigation process. This will be discussed during the webinar. Students that did not attend the final webinar will be required to provide a synopsis of the article.

Assignment 2: Wrap up Essay - Students will provide a 2-part essay answering (1) what they believe will be the best part of being a BMET and (2) what will be the most challenging aspect of being a BMET.

Assignment 3: Final Project Draft - Final Draft - Student's will submit their final draft for their final project. The final project consists of an APA format essay and a power point presentation based on equipment that the students researched, identifying 3 simple user correctable issues to develop user training for.

Assignment 4: End of Course Survey: Students will submit a survey on the instruction material and the instructor.

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

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

Course Grade Distribution

Discussion Board Requirements	25%
Weekly Webinars and Assignments	25%
Weekly Quizzes	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 at least 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 wordcount 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 (25% 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 (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. Worksheets are assigned in weeks two and four. Homework may include many requirements, ranging from written assignments, research projects, PowerPoint presentations, and many other activities. In all cases, instructors will try to ensure that students understand the requirements and expectations.

Exams (25%)

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. 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 not completed within 7 business days after 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 time. 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>

NOTE: THE INSTRUCTOR RESERVES THE RIGHT TO MODIFY THIS SYLLABUS and COURSE OUTLINE