



Western Technical College

10605201 Healthcare Systems & Tech Troubleshooting

Course Outcome Summary

Course Information

Description	This course covers medical devices and systems analysis and troubleshooting. Emphasis is placed on understanding, testing, and troubleshooting medical devices particularly in relation to their safe operation. Content includes tool skills, review of electronics, overview of mechanical systems, utilization of operators/service manuals, and operation of test equipment while working on medical devices.
Career Cluster	Science, Technology, Engineering and Mathematics
Instructional Level	Associate Degree Courses
Total Credits	3
Total Hours	90

Pre/Corequisites

Prerequisite	10605209 BioMed Codes/Standards/Procedures
Prerequisite	10605206 Medical Instrumentation
Prerequisite	10660125 Electronic Devices

Textbooks

No textbook required.

Success Abilities

1. Cultivate Passion: Increase Self-Awareness
2. Live Responsibly: Foster Accountability
3. Refine Professionalism: Improve Critical Thinking

4. Refine Professionalism: Participate Collaboratively
5. Refine Professionalism: Practice Effective Communication

Course Competencies

1. Apply safety practices while working on equipment.

Assessment Strategies

- 1.1. Written Objective Test
- 1.2. Self-Assessment
- 1.3. Skill Demonstration
- 1.4. Performance Exam

Criteria

You will know you are successful when

- 1.1. You are mindful of what you are doing with all activities and consider before you act.
- 1.2. You use appropriate PPE for the situation.
- 1.3. You lift with your legs not your back and only up to your individual capability.
- 1.4. You use appropriate safety procedures for any hand or powered equipment and tools.
- 1.5. You de-energize all power sources or use appropriate precautions while working on energized equipment.
- 1.6. You use proper techniques and equipment to protect against damaging electrostatic discharge while working on equipment.
- 1.7. You keep batteries, capacitors, and power sources from being shorted out.
- 1.8. You store or dispose of batteries and electronics in a safe and environmental manner.
- 1.9. You follow all guidelines on SDS for all chemicals and cleaners.

Learning Objectives

- 1.a. Use proper lifting technique.
- 1.b. Use mechanical safety techniques when working on mechanical systems.
- 1.c. Employ electrical safety practices while working on electronic and powered equipment.
- 1.d. Use safe handling methods with batteries and power systems.
- 1.e. Use appropriate precautions when using cleaners and chemicals.
- 1.f. Employ techniques to guard against damaging Electro Static Discharge.

2. Use mechanical systems including: hand tools, power equipment, and hardware.

Assessment Strategies

- 2.1. Written Objective Test
- 2.2. Self-Assessment
- 2.3. Skill Demonstration
- 2.4. Performance Exam

Criteria

You will know you are successful when

- 2.1. You name hand tools, power equipment, and hardware.
- 2.2. You select specified hand tools, power equipment, and hardware.
- 2.3. You determine the appropriate tool, equipment, or hardware for a specific application.
- 2.4. You use the tool, equipment, or hardware in an effective manner, accomplishing the desired task, without incurring injury or creating damage.

Learning Objectives

- 2.a. Identify a wide variety of hand tools, power equipment, and hardware.
- 2.b. Select the correct tool, equipment, or hardware for specific applications.
- 2.c. Use the tool, equipment, or hardware correctly.

3. Use electronic test equipment.

Assessment Strategies

- 3.1. Written Objective Test
- 3.2. Self-Assessment

- 3.3. Skill Demonstration
- 3.4. Performance Exam

Criteria

You will know you are successful when

- 3.1. You name electronic test equipment.
- 3.2. You select specified electronic test equipment.
- 3.3. You determine the appropriate electronic test equipment for a specific application.
- 3.4. You use the electronic test equipment in an effective manner, accomplishing the desired task, without incurring injury or creating damage.

Learning Objectives

- 3.a. Identify a wide variety of electronic test equipment.
- 3.b. Select the correct electronic test device for specific applications.
- 3.c. Use the electronic test equipment correctly.

4. Use technical documentation.

Assessment Strategies

- 4.1. Written Objective Test
- 4.2. Self-Assessment
- 4.3. Skill Demonstration
- 4.4. Performance Exam

Criteria

You will know you are successful when

- 4.1. You describe the use of operators and different types of service manuals.
- 4.2. You use the technical documentation to obtain the information you are looking for regarding a medical device.
- 4.3. You answer questions about medical devices by using appropriate technical documentation.
- 4.4. You identify, by name and function, the electronic/mechanical/hydraulic/pneumatic schematic symbols and the real-life components they correspond to and visa-versa.
- 4.5. You explain the purpose of different formats of technical information or troubleshooting aids.
- 4.6. You use different formats of technical information while testing and troubleshooting medical equipment.
- 4.7. You follow procedures as they are written; for medical equipment; when testing, or troubleshooting a medical device.

Learning Objectives

- 4.a. Explain different types of technical documentation.
- 4.b. Locate appropriate sections in technical documentation.
- 4.c. Read technical documentation.
- 4.d. Use different types of information and troubleshooting aids provided in technical documentation.
- 4.e. Explain Theory of Operation, Flow Charts, Block Diagrams, Parts Location Blowouts, Schematics, Error Code Lists, Procedures, and more.

5. Practice communications with other service personnel.

Assessment Strategies

- 5.1. Written Objective Test
- 5.2. Self-Assessment
- 5.3. Skill Demonstration
- 5.4. Performance Exam

Criteria

You will know you are successful when

- 5.1. You list different methods of in-person and distance communication.
- 5.2. You identify the information that other service or technical support person would need to understand the equipment issue.
- 5.3. You demonstrate communication methods in class with classmates, taking different roles in different role playing scenarios.

Learning Objectives

- 5.a. List different methods of communications commonly used with other service personnel.
- 5.b. Describe how to prepare for communications with other service personnel.
- 5.c. Practice different forms of communications with service personnel.

6. Examine mechanical/electronic actuators and components.

Assessment Strategies

- 6.1. Written Objective Test
- 6.2. Self-Assessment
- 6.3. Skill Demonstration
- 6.4. Performance Exam

Criteria

You will know you are successful when

- 6.1. You state the common applications for electrical, electronic, hydraulic, pneumatic, and mechanical components and systems.
- 6.2. You identify a component or system as electrical, electronic, hydraulic, pneumatic, or mechanical by using equipment documentation.
- 6.3. You identify a component or system as electrical, electronic, hydraulic, pneumatic, or mechanical by observing the equipment and comparing it to the documentation.
- 6.4. You identify a variety of common mechanical/electronic actuators by name and operating characteristics. (Pumps, motors, heaters, suction, compressor, lifts)
- 6.5. You state the common maintenance activities or failures with electrical, electronic, hydraulic, pneumatic, and mechanical components or systems.

Learning Objectives

- 6.a. Explain the difference between electrical, electronic, hydraulic, pneumatic, and mechanical systems.
- 6.b. Identify the type of system based on equipment documentation or actual components.
- 6.c. Identify a variety of different mechanical/electronic actuators.
- 6.d. List typical maintenance required for different mechanical/electronic actuators.

7. Explain electrical power systems and components.

Assessment Strategies

- 7.1. Written Objective Test
- 7.2. Self-Assessment
- 7.3. Skill Demonstration
- 7.4. Performance Exam

Criteria

You will know you are successful when

- 7.1. You summarize the components of an electrical distribution system and its return path.
- 7.2. You explain the characteristics, contacts, waveforms, and applications of single phase power.
- 7.3. You explain the characteristics, contacts, waveforms, and applications of three phase power.
- 7.4. You describe the possible combinations of delta and wye connections and their resulting applications and waveforms.
- 7.5. You identify various types of fuses and circuit breakers along with their connections and applications for equipment and power distribution systems.
- 7.6. You describe different types of power supplies by name, characteristics, and applications; including linear, switching, and battery power supplies.

Learning Objectives

- 7.a. Explain electrical power distribution.
- 7.b. Explain single phase power.
- 7.c. Explain three phase power.
- 7.d. Explain connections to three phase power.
- 7.e. Explain overcurrent protection within devices and power distribution systems.
- 7.f. Explain equipment power supplies.

8. Explain battery power management.

Assessment Strategies

- 8.1. Written Objective Test

- 8.2. Self-Assessment
- 8.3. Skill Demonstration
- 8.4. Performance Exam

Criteria

You will know you are successful when

- 8.1. You describe different battery types including their name, characteristics, and with what types of medical equipment they are commonly used.
- 8.2. You describe the goals of battery management as part of the medical equipment management system and repercussions of battery failure.
- 8.3. You explain the correct disposal methods for different battery types including the application of sustainability, economics, and safety.
- 8.4. You describe the maintenance requirements of individual battery types.

Learning Objectives

- 8.a. Describe different battery types.
- 8.b. Describe the goals of battery management.
- 8.c. Explain the correct disposal methods for different battery types.
- 8.d. Explain the battery maintenance procedures for different battery types.
- 8.e. Explain battery policies commonly in place in clinical settings for medical equipment.

9. Test a variety of medical devices.

Assessment Strategies

- 9.1. Written Objective Test
- 9.2. Self-Assessment
- 9.3. Skill Demonstration
- 9.4. Performance Exam

Criteria

You will know you are successful when

- 9.1. You identify medical devices by name, appropriate categories, functions, and applications.
- 9.2. You identify testing procedures for a medical device within technical documentation or devise appropriate testing procedures based on analysis of the device.
- 9.3. You select the correct supplies and test equipment to perform specific test procedures on a variety of medical devices.
- 9.4. You use the appropriate test procedures to test a variety of medical devices.
- 9.5. You analyze the results of the testing procedures to determine if the medical device is performing to equipment specifications and expected operation.
- 9.6. You identify and document symptoms if tested medical device is determined to be not performing adequately.

Learning Objectives

- 9.a. Identify a wide variety of medical devices.
- 9.b. Determine appropriate test procedure for medical devices.
- 9.c. Determine the needed supplies and test equipment to test medical devices.
- 9.d. Test medical devices using the appropriate test procedures.
- 9.e. Determine if tested medical device is performing correctly.
- 9.f. Identify symptom(s) for medical devices that are not performing up to specifications.

10. Perform basic maintenance procedures on a variety of medical devices.

Assessment Strategies

- 10.1. Written Objective Test
- 10.2. Self-Assessment
- 10.3. Skill Demonstration
- 10.4. Performance Exam

Criteria

You will know you are successful when

- 10.1. You list common maintenance procedures for medical devices.

- 10.2. You explain the deleterious effects dust can have on contacts, air flow, and equipment function.
- 10.3. You explain the need for cleanliness of medical equipment both from the aesthetic and pathogen aspects.
- 10.4. You use tools and chemical products that are effective and not damaging to medical devices during maintenance procedures and as specified in available technical documentation.
- 10.5. You test chemical products in inconspicuous spots before deploying on entire device if unsure of that chemicals appropriateness for that application.
- 10.6. You arrange equipment, cords, and accessories in a neat, secure, and safe manner after working on medical equipment.

Learning Objectives

- 10.a. List several different types of common maintenance procedures.
- 10.b. Explain the need to keep electronics clean and free of dust.
- 10.c. Use the correct tools and chemical products while maintaining medical equipment.
- 10.d. Demonstrate proper cord and accessory management.

11. Repair mechanical connections and hardware.

Assessment Strategies

- 11.1. Written Objective Test
- 11.2. Self-Assessment
- 11.3. Skill Demonstration
- 11.4. Performance Exam

Criteria

You will know you are successful when

- 11.1. You identify different types of connections and hardware by name, application, and appropriate use with them.
- 11.2. You use the correct tool in the correct manner and avoid damaging any of the equipment while accomplishing the desired mechanical task.
- 11.3. You remove stuck hardware through the use of a variety of tools, methods, and chemicals.
- 11.4. You determine if the connectors/hardware/attachment point must be replaced.
- 11.5. You repair damaged connectors/hardware and equipment attachment points with the appropriate tool

Learning Objectives

- 11.a. Identify different types of connections and hardware.
- 11.b. Use tool skills when working with connections and hardware.
- 11.c. Use techniques to remove stuck connection and hardware.
- 11.d. Repair different damaged connectors/hardware and attachment points on equipment.

12. Complete cosmetic repairs to equipment.

Assessment Strategies

- 12.1. Written Objective Test
- 12.2. Self-Assessment
- 12.3. Skill Demonstration
- 12.4. Performance Exam

Criteria

You will know you are successful when

- 12.1. You explain why equipment appearance relates to patient and staff confidence in equipment.
- 12.2. You differentiate which option for repair is needed.
- 12.3. You make an appropriate selection of cosmetic repair for the specific damage based on considered options.
- 12.4. You prepare damaged surface to remove apparent damage and ensure that touch-up material will adhere to surface.
- 12.5. You apply the appropriate touchup material in a cosmetic and neat manner.
- 12.6. You evaluate results of cosmetic repair
- 12.7. You determine if 1) repaired device is neat and well maintained or 2) further repair is required or 3) repair is not possible.
- 12.8. You prepare equipment with accessories, documentation, cables, and stands in a neat and organized manner; and engage any safety features.

Learning Objectives

- 12.a. Explain why equipment should be cosmetically repaired.
- 12.b. Select the appropriate action to cosmetically repair equipment such as paint, sanding, patches, and replacing damaged material..
- 12.c. Prepare damaged surface for repair.
- 12.d. Apply touch-up material to damaged surface.
- 12.e. Determine the result of cosmetic repair.
- 12.f. Prepare equipment in a professional manner.

13. Identify troubleshooting techniques.

Assessment Strategies

- 13.1. Written Objective Test
- 13.2. Self-Assessment
- 13.3. Skill Demonstration
- 13.4. Performance Exam

Criteria

You will know you are successful when

- 13.1. You explain common simple-to-repair problems such as lack of connection, lost or incorrect power, failed accessories, and incorrect setup.
- 13.2. You document the troubleshooting process including detailed list of symptoms, taking photos or recordings of symptoms, taking photos or recordings of assembly/disassembly, making notes during process, labeling equipment as needed, and writing up results of TS process in an appropriate system.
- 13.3. you explain a variety of troubleshooting techniques such as observation, stepping back, detailing symptoms, divide and conquer, chunk it up, check the easiest 1st, and check the most likely.

Learning Objectives

- 13.a. List common equipment faults.
- 13.b. Describe common problems such as lack of connection, lost or incorrect power, failed accessories, and incorrect setup.
- 13.c. Develop documentation that includes detailed list of symptoms, taking photos or recordings of symptoms, taking photos or recordings of assembly/disassembly, making notes during process, labeling equipment as needed, and writing up results of TS process in an appropriate system.
- 13.d. Use documentation for troubleshooting medical equipment.
- 13.e. Explain a variety of troubleshooting techniques such as observation, stepping back, detailing symptoms, divide and conquer, chunk it up, check the easiest 1st, and check the most likely.
- 13.f. Use a variety of troubleshooting techniques.

14. Troubleshoot a variety of medical devices.

Assessment Strategies

- 14.1. Written Objective Test
- 14.2. Self-Assessment
- 14.3. Skill Demonstration
- 14.4. Performance Exam

Criteria

You will know you are successful when

- 14.1. you identify devices by their generic name and clinical application.
- 14.2. you identify specific pieces of equipment by specific name, model, make, serial number.
- 14.3. you analyze problems using all senses and employing testing procedures.
- 14.4. you use technical documentation and web information on generic or specific type of equipment and/or specific operators/service manuals and other manufacturer's information.
- 14.5. you document the symptoms and results of any tests in writing.
- 14.6. you troubleshoot device making modifications to approach as warranted based on results of troubleshooting activities.
- 14.7. you carry out repair activity on device.
- 14.8. you test device thoroughly to determine if all failure symptoms are resolved and if not return to troubleshooting process.

Learning Objectives

- 14.a. Identify device.
- 14.b. Analyze device operation.
- 14.c. Troubleshoot device.
- 14.d. Repair device.
- 14.e. Evaluate outcome.

15. Troubleshoot electronic systems.

Assessment Strategies

- 15.1. Written Objective Test
- 15.2. Self-Assessment
- 15.3. Skill Demonstration
- 15.4. Performance Exam

Criteria

You will know you are successful when

- 15.1. You identify electronic components by physical part, function, and schematic symbol.
- 15.2. You identify electronic circuits function.
- 15.3. You explain electronic circuit function using schematic diagrams.
- 15.4. You use test equipment to measure electronic circuit operation.
- 15.5. You use schematics and test equipment to troubleshoot electronic circuits.

Learning Objectives

- 15.a. Identify electronic components.
- 15.b. Identify electronic circuits.
- 15.c. Analyze electronic circuits.
- 15.d. Test electronic circuits.
- 15.e. Troubleshoot electronic circuits.