



## Course Number and Title: ELC 261 Biomedical Instrumentation II

**Campus Location:**

Dover

**Effective Date:**

2018-51

**Prerequisite:**

ELC 260

**Co-Requisites:**

none

**Course Credits and Hours:**

4.00 credits

3.00 lecture hours/week

3.00 lab hours/week

**Course Description:**

This course reinforces and applies the operation and maintenance of biomedical equipment through classroom and laboratory environment. Students strengthen skills to evaluate, test, troubleshoot, and repair various types of equipment commonly used in the medical field.

**Required Text(s):**

Obtain current textbook information by viewing the [campus bookstore - https://www.dtcc.edu/bookstores](https://www.dtcc.edu/bookstores) online or visit a campus bookstore. Check your course schedule for the course number and section.

**Additional Materials:**

None

**Schedule Type:**

Classroom Course

**Disclaimer:**

The list of Measureable Performance Objectives is drawn from Electronics Technician Association, Int'l Biomedical Electronics Technician Competency Requirements.

**Core Course Performance Objectives (CCPOs):**

1. List and describe the instrumentation used to support hemodialysis. (CCC 1, 2, 6; PGC 2, 3, 4)
2. Examine the instrumentation used to support medical ultrasounds. (CCC 2, 6; PGC 2, 3, 4)
3. List and describe the instrumentation used to support radiology. (CCC 1, 2, 6; PGC 2, 3, 4)
4. List and describe the instrumentation used to support an operating room. (CCC 1, 2, 6; PGC 2, 3, 4)
5. List and describe the instrumentation used to support respiratory treatment. (CCC 1, 2, 6; PGC 2, 3, 4)
6. Describe, troubleshoot, and repair the instrumentation used to support a medical laboratory (CCC 1, 2, 6; PGC 2, 3, 4, 5)
7. List and describe electrosurgery generators. (CCC 1, 2, 6; PGC 2, 3, 4)
8. List and describe the instrumentation used in a cardiac support system. (CCC 1, 2, 6; PGC 2, 3, 4)
9. Evaluate medical equipment to determine whether or not equipment is operating within service manual specifications. (CCC 1, 2, 6; PGC 2, 3, 4, 5)

See Core Curriculum Competencies and Program Graduate Competencies at the end of the syllabus. CCPOs are linked to every competency they develop.

**Measurable Performance Objectives (MPOs):**

Upon completion of this course, the student will:

1. List and describe the instrumentation used to support hemodialysis.
  1. Describe the functions of the kidneys.
  2. Define terms used in the study of the kidneys.
  3. Explain why kidney failure requires hemodialysis treatment.
  4. State the functions of the dialysis machine.
  5. Sketch the main function blocks of a dialysis machine including power supply, pressure monitor, blood pump, temperature system, bath delivery system, drain system, circulating system, and control panel.
  6. Explain the function of each block or section of the machine.
  7. State the special safety precautions associated with the wet environment of a dialysis machine such as the magnetically coupled motor shaft impeller system and ground fault interrupters.
  8. State some of the common problems with dialysis machines.

2. Examine the instrumentation used to support medical ultrasounds.
  1. Explain the purpose of ultrasound in medical applications.
  2. Define the terms associated with ultrasound.
  3. Explain the physics of sound waves with respect to wavelength (w.r.t.), wavelength, velocity, period, frequency, reflection, refraction, and resonator.
  4. Explain the biological effects of ultrasound.
  5. Describe the operation of the instruments used in delivering ultrasound such as the Doppler flow meter, blood pressure monitor, fetal monitor, echocardiography, and echoencephalography.
  6. Describe the operation of ultrasound instruments.
  7. List safety precautions regarding the maintenance and use of ultrasound instruments.
  8. Describe the types of transducers used in medical diagnostic ultrasound.
  9. Distinguish between sector scans and linear scans.
  10. Define *axial resolution* and *lateral resolution*.
  11. Define *dead zone* as it applies to ultrasound.
  12. Describe the front end of an ultrasound scanner.
  13. Define *scan conversion*.
  14. Distinguish between spectral doppler and color flow doppler.
  15. Define and describe a digital imaging and communications in medicine (DICOM) system.
  16. Explain the components of a video signal.
3. List and describe the instrumentation used to support radiology.
  1. List the main functions of an X-ray machine.
  2. Describe the therapeutic applications of X-ray machines.
  3. State the diagnostic (measurement) function of an X-ray machine.
  4. State the different categories of X-ray machines such as still picture, continuous, and motion picture.
  5. List the dangers associated with X-rays.
  6. Name the units used for measuring radioactivity including Curie, Roentgen, and dose rate.
  7. Explain the terms used in the study of radiology.
  8. Sketch the circuit diagram of an X-ray tube.
  9. Sketch the circuit diagram of a Geiger-Mueller tube.
  10. Explain how X-ray tubes work.
  11. Discuss the safety precautions associated with the handling of X-ray tubes.
  12. Sketch the circuit diagram of an X-ray machine.
4. List and describe the instrumentation used to support an operating room.
  1. Describe the functions of the operating room (OR).
  2. Describe the protocols involved in working in the OR.
  3. List the duties of the personnel employed in the OR including the nursing staff, biomedical technician, surgeon.
  4. List the special equipment used in the OR.
  5. List the functions of the equipment used in the OR.
  6. Describe why anesthetics are used and what types are commonly used.
  7. List the safety precautions observed in the OR.
  8. List the different methods of sterilization.
  9. Define terms used in surgery.
  10. Describe different methods of sterilization.
5. List and describe the instrumentation used to support respiratory treatment.
  1. List the principle pulmonary capacity parameters measured, and describe the various respiratory transducers.
  2. List the instruments used with the respiratory system.
  3. Describe the function of the instruments used in the respiratory system.
  4. Define the various volumes measured including tidal, inspiratory reserve, expiratory reserve, residual minute.
  5. Describe the operation of adult and pediatric ventilators.
6. Describe, troubleshoot, and repair the instrumentation used to support a medical laboratory.
  1. State the main functions and composition of blood.
  2. List the instruments used in the medical laboratory including calorimeters, photometers, spectrophotometers, pH analyzers, autoanalyzers, chromatographs, dialyzers).
  3. State the maintenance procedures for the following medical lab instruments:
    1. Blood gas analyzers
    2. Co-oximeters
    3. Centrifuges
    4. Microscopes
    5. Cell counters
    6. Chemistry analyzers
7. List and describe electrosurgery generators.
  1. Describe the function of the electrosurgery (ESU) generator.
  2. Describe the operation of the electrosurgery generator.
  3. Sketch the block diagram and related waveforms of an electrosurgery generator.
  4. List the safety measures to be adopted when using the electrosurgery generator.
  5. Describe the type of waveforms generated such as coagulate and cut.
  6. List the frequencies commonly used by electrosurgical scalpels.

7. Describe rapid eye movement (REM) sleep.
8. Describe testing requirements for electrosurgery units.
8. List and describe the instrumentation used in a cardiac support system.
  1. Describe the principles of defibrillation.
  2. Describe the principles and operation of the pacemaker.
  3. Describe the principles and operation of the cardioverter.
  4. Describe the principles and operation of the intra-aortic balloon pump.
  5. List three types of cardiac arrhythmias.
  6. Describe the events taking place in each part of the electrocardiogram (ECG) waveform.
  7. Detail the minimum energy required from an implantable pacemaker.
  8. Detail the minimum energy required from an external pacemaker.
  9. Troubleshoot problems associated with cardiac support machines.
  10. Describe the principles and operation of the cell saver machine.
  11. Sketch the main parts of a basic cardiopulmonary bypass circuit.
  12. Describe all the available types of blood pumps including the roller pump, modified roller pump for pulsatile perfusion and centrifugal pump.
  13. Describe the general steps for proper testing of a defibrillator.
9. Evaluate medical equipment to determine if equipment is operating within service manual specifications.
  1. Evaluate medical equipment using general test equipment to determine if the equipment is operating within normal parameters.
  2. Evaluate medical equipment using specialized test equipment to determine if the equipment is operating within normal parameters.

**Evaluation Criteria/Policies:**

Students must demonstrate proficiency on all CCPOs at a minimal 75 percent level to successfully complete the course. The grade will be determined using the Delaware Tech grading system:

92	-	100	=	A
83	-	91	=	B
75	-	82	=	C
0	-	74	=	F

Students should refer to the [Student Handbook - https://www.dtcc.edu/handbook](https://www.dtcc.edu/handbook) for information on the Academic Standing Policy, the Academic Integrity Policy, Student Rights and Responsibilities, and other policies relevant to their academic progress.

**Core Curriculum Competencies (CCCs are the competencies every graduate will develop):**

1. Apply clear and effective communication skills.
2. Use critical thinking to solve problems.
3. Collaborate to achieve a common goal.
4. Demonstrate professional and ethical conduct.
5. Use information literacy for effective vocational and/or academic research.
6. Apply quantitative reasoning and/or scientific inquiry to solve practical problems.

**Program Graduate Competencies (PGCs are the competencies every graduate will develop specific to his or her major):**

1. Perform the duties of an entry-level technician using the skills, modern tools, theory, and techniques of the electronics engineering technology.
2. Apply a knowledge of mathematics, science, engineering, and technology to electronics engineering technology problems that require limited application of principles but extensive practical knowledge.
3. Conduct, analyze, and interpret experiments using analysis tools and troubleshooting methods.
4. Apply critical thinking skills necessary to analyze, install and maintain biomedical electronic systems and equipment
5. Troubleshoot and repair malfunctioning electronic circuits, systems and networks found in a healthcare environment or associated industries
6. Explain the importance of engaging in self-directed continuing professional development.
7. Demonstrate basic management, organizational, and leadership skills which commit to quality, timeliness and continuous improvement.

**Disabilities Support Statement:**

The College is committed to providing reasonable accommodations for students with disabilities. Students are encouraged to schedule an appointment with the campus Disabilities Support Counselor to request an accommodation needed due to a disability. A listing of campus Disabilities Support Counselors and contact information can be found at the [disabilities services - https://www.dtcc.edu/disabilitysupport](https://www.dtcc.edu/disabilitysupport) web page or visit the campus Advising Center.