



**MediSend**  
**Biomedical Equipment**  
**Technology Program®**  
**BMET**

- Program and Curriculum Description -

# The MediSend Biomedical Equipment Technology Program

## OVERVIEW

A *biomedical equipment technician* is a highly skilled electromechanical technician that installs, inspects, troubleshoots, calibrates, and maintains medical, instrumentation and support systems of moderate complexity used in healthcare delivery. This individual, under minimal technical supervision, has technical competence to ensure that medical equipment is safe, functional and properly configured. The biomedical equipment technician also serves as an advisor to nursing and administrative staff in the safe use and proper operation of biomedical equipment and in developing specifications for and the selection of new items of medical equipment.

The Biomedical Equipment Technology Program (*The BMET Program*) prepares individuals to install, calibrate, operate, maintain and troubleshoot sophisticated devices and instrumentation, which are critical for effective delivery of health care. Emphasis is placed on proper installation and operation, as well as on repair, and preventive and safety inspections to ensure biomedical equipment meets all applicable safety standards. The course work builds a strong foundation in engineering mathematics, algebra, physics, anatomy, physiology, electronics, clinical chemistry, physiological sensors & transducers, computer networking, introduction to clinical areas, and various troubleshooting techniques. The curriculum stresses a practical, hands-on understanding of the fundamental principles, operations and design of the more common, standard medical devices and instrumentation (e.g. electrocardiographs, defibrillators, patient monitors, ventilators, ultrasound systems, clinical laboratory analyzers, etc.) as well as in troubleshooting and proper maintenance.

The comprehensive education and training program includes: a review of medical device-related standards and protocols; knowledge of the clinical use of testing and diagnostic instruments, hands on application of calibrating techniques and engineering problem-solving methodologies; awareness of potential fire, chemical, biological and electrical hazards and related safety precautions; development of communication and customer support skills, management and leadership skills, and performance assurance-testing procedures. The curriculum not only prepares individuals for an entry level into the biomedical technician (BMET) profession, but also gives them the necessary education and experience to sit for the ICC (International Certification Commission) Certified Biomedical Equipment Technician (CBET) exam.

## ADMISSION REQUIREMENTS

Admission decisions are based on a combination of factors, including: academic background, relevant work experience, exam scores, answers to the essay questions, phone interviews, and commitment to improving community health. Selection is made at the sole discretion of MediSend International.

To be considered for enrollment in the Biomedical Equipment Technology Program, candidates must meet or exceed ALL of the following criteria:

- ✓ Pass and Entrance Exam comprising of multiple-option questions, exercises and problems of general science, basic physics, chemistry, electricity, electronic components and circuits, engineering algebra and mathematics
- ✓ Have a High School Diploma
- ✓ Proof of military service and honorable discharge

### *Helpful Experience:*

- Technical school or military training in Electrical/Mechanical Engineering, Information Technology, Computer Science or similar curriculum

- Military work experience in a technical specialty (e.g. technician, mechanic, electrician, lab specialist, med tech or similar technical specialties)
- College/university studies in Electrical/Mechanical Engineering, Biomedical Engineering, Physics, Chemistry, Computer Science, Information Technology or similar curriculum

## PROGRAM DESCRIPTION

The BMET Program prepares students for an entry-level profession in the field of Biomedical Equipment Technology (BMET) as BMET, Level I Technicians. The BMET Program is designed to educate, train and empower individuals to become partners in the effective delivery of health care through specialized education and training—ultimately building core capacity to strengthen and sustain community health care systems.

The 5-month very intensive, outcome-oriented curriculum is centered on biomedical equipment repair and integrates courses featuring six scientific disciplines and more than 30 biomedical instrumentation technologies. With a curriculum of more than 860 hours of classroom lectures, laboratory hands-on practical experience in installing, utilizing, and repairing medical equipment, the program has been tailored to provide education and competency covering basic critical medical instrumentation found in hospitals.

Students are initially reintroduced to essential science and math disciplines along with the fundamentals of troubleshooting, biomedical instrumentation, and sensors. With this foundation, they are instructed in the practical operation, repair, and calibration of modern medical equipment, as well as professional and ethical conduct through courses in management and leadership. The students also learn how to use and implement a hospital equipment maintenance program, using modern information technologies.

As part of the program, top manufacturers provide professional instructors and certified training courses on medical equipment used in the MediSend BMET training laboratory. The students also have the opportunity for a professional internship experience in several Dallas-area hospitals. The internship allows them to work with experienced, practicing biomedical technicians and to employ their newly acquired skills in a hands-on clinical environment; enhancing their training and technical competence through real-world problem solving in the biomedical domain.

Since the BMET Program is conducted in a “real-world” interactive and hands-on environment, graduates are prepared to function as professional technicians, with courses in biomedical equipment repair, specialized computer technology, and analog and digital electronics. The BMET Program exposes students to cutting-edge science and technology, and features lab practicum, classroom lectures, seminars, professional internship, workshops and individual projects. These various settings encourage the development of marketable skills in the area of engineering, research and development, customer support and sales, budget planning, computer networking technology, management and leadership.

## PROGRAM STRUCTURE AND DURATION

*The BMET Program* is a combined 5-month very intensive training program that consists of two parts: *Basic* and *Intermediate*.

- In the *Basic BMET Program* the students first learn the fundamentals of troubleshooting electronic circuits, technology concepts, and methods in designing biomedical instrumentation. They are then introduced to the field of installing, operating, repairing, and providing corrective and preventive maintenance of basic general biomedical equipment and instrumentation.
- In the *Intermediate BMET Program* the students develop professional competence by working with more advanced and sophisticated biomedical equipment technology and clinical laboratory instrumentation such as electrocardiographs, patient monitoring systems, defibrillators, ventilators, ultrasound systems, clinical chemistry and hematology analyzers.

## PROGRAM OUTLINE

Subject #	Subject Title	Clock Hours Lec/Lab/Ext/Total	Semester Credit Hours
<u>Basic BMET Program</u>			
BMT 100	Introduction to Computer and Computer Applications	24/00/00/24	1.5
BMT 101	Engineering Mathematics and Algebra	32/00/00/32	2.0
BMT 102	First Aid/CPR/AED and Bloodborne Pathogens	16/00/00/16	NA
BMT 103	Fundamentals of Biomedical Equipment Troubleshooting	24/20/00/44	2.5
BMT 104	Physics Engineering: DC Circuits	68/32/00/100	5.0
BMT 105	Physics Engineering: AC Circuits	40/20/00/60	4.0
BMT 106	Electronic Devices and Circuits	56/36/00/92	5.0
BMT 107	Biomedical Instrumentation, Sensors, and Transducers	06/02/00/08	0.5
BMT 108	Laboratory Equipment: Clinical Centrifuges	18/10/04/32	2.0
BMT 109	Aspiration and Suction Devices: Aspirators and Suction Pumps	10/18/04/32	2.0
BMT 110	Humidity and Aerosol Therapy Devices: Humidifiers, Nebulizers and Medical Compressors	02/02/04/08	0.5
BMT 111	Medical Temperature Measuring Devices: Handheld Digital Thermometers and Temperature Monitoring Sensors	05/03/00/08	0.5
BMT 112	Infant Care: Infant Incubators and Warmers	08/08/00/16	1.0
BMT 113	Sterilizing Equipment: Steam Sterilizers and Hot Air Ovens	14/10/04/28	2.0
BMT 114	Medication Management and Enteral Delivery Systems: General Infusion, Pain Management, Syringe and Feeding Pumps	14/14/04/32	2.0
BMT 115	Hospital Ancillary Equipment: Beds, Tables, Stretchers, and Wheelchairs	02/06/00/08	0.5
<u>Intermediate BMET Program</u>			
BMT 200	Cardiac Anatomy and Physiology of the Human Body	08/00/00/08	0.5
BMT 201	Patient Monitoring Systems: Non-Invasive Blood Pressure & Vital Signs Monitors	10/10/00/20	1.0
BMT 202	Diagnostic Equipment: Electrocardiograph	16/12/00/28	2.0
BMT 203	Patient Monitoring Systems: Bedside Monitors	14/14/04/32	2.0
BMT 204	Cardiology Equipment: Defibrillators	14/14/04/32	2.0
BMT 205	Ultrasound Physics, Sensors and Transducers	16/00/00/16	1.0
BMT 206	Vascular/Fetal Doppler Monitoring Systems	04/00/04/08	0.5
BMT 207	Imaging Equipment: Ultrasound Systems	40/24/00/64	4.0
BMT 208	Anatomy and Physiology of the Human Respiratory System	08/00/00/08	0.5
BMT 209	Oxygen Supply Systems: Oxygen Concentrator	04/04/00/08	0.5
BMT 210	Respiratory Care Equipment: Ventilators	12/08/04/24	1.5
BMT 211	BMT 211 – Ancillary Equipment for Clinical Laboratory	04/00/04/08	0.5
BMT 212	Fundamentals of Spectrophotometry and Clinical Chemistry Instrumentation	28/12/00/40	2.5
BMT 213	Laboratory Equipment: Microscopes	05/03/00/08	0.5
BMT 214	Introduction to Hematology Instrumentation	12/04/00/16	1.0
<b>Total Hours</b>		<b>534/286/40/860</b>	<b>51</b>

## OUTCOMES

The BMET graduates will be able to:

- Utilize information gathered through troubleshooting process and develop and communicate an action plan to correct medical equipment, patient and user issues in a timely and efficient manner
- Identify, analyze, and solve open-ended problems with medical relevance such as those encountered during installation, inspection, repair, and calibration, as well as verify performance and networking of a broad range of biomedical instrumentation with minimal technical supervision
- Show competence in the corrective and preventive maintenance of biomedical equipment as well as in the use of all applicable test equipment and tools required in the performance of their duties; work independently and as a member of a team while maintaining a high-level of professionalism
- Serve as an advisor to medical and administrative staff in the safe use and proper operation of biomedical equipment and in developing specifications for and selection of new items of medical instrumentation
- Communicate in a clear, concise written and verbal manner to all levels of clinical and non-clinical staff
- Apply advanced concepts of team building, management, and leadership to various situations, thereby encouraging participation in decision-making within their community government structure
- Advance to leadership positions within their community healthcare clinics and biomedical workshops
- Demonstrate safe working habits and apply universal safety procedures in the handling of chemical, radiological, and biological materials and processes
- Sit for the ICC (International Certification Commission) Certified Biomedical Equipment Technician (CBET) exam

## SUBJECT DESCRIPTIONS

### **BMT 100 - Introduction to Computers and Computer Applications**

The course "Introduction to Computers and Computer Applications" introduces students to personal computers, computer hardware and software, and peripheral devices connected to a personal computer. This course is taught throughout the 5-month BMET program. The students learn how to use computers as a business and personal tool through a variety of software packages. Appropriate software for database management, word processing, graphics, E-mail, Internet Research, MS PowerPoint, and spreadsheets is used. Students also perform activities using integrated software programs. The class is highly interactive and requires the input of all students on a regular basis to work collaboratively with their peers, both informally and on more formally structured projects. Emphasis is placed on preparing students to be self-sufficient learners as they move toward higher education. The course combines computer-aided-instruction and online assignments to provide the student with a base of knowledge, skills and techniques essential to identify, formulate and solve engineering problems in the field of biomedical equipment technology. The virtual classroom allows for live interaction between student and the trainer, enabling students to ask questions, take simulations and quizzes.

- 24 clock hours (24 hrs lecture and practical exercises, 00 hrs lab-practicum, 00 hrs externship)
- 1.5 Semester Credit Hours
- Prerequisites: None

### **BMT 101 - Engineering Mathematics and Algebra**

Engineering Mathematics and Algebra (course available on the Internet) is designed as a thorough review for students who already possess some knowledge of engineering mathematics and algebra. It emphasizes the application of basic mathematical, scientific and associated engineering principles to a variety of biomedical equipment construction and applications. The course combines computer-aided-instruction and online assignments to provide the student with a base of knowledge, skills and techniques essential to identify, formulate and solve engineering problems in the field of biomedical equipment technology. The virtual classroom allows for live interaction between student and the trainer, enabling students to ask questions, take

simulations and quizzes. The course is required to be completed from home, or wherever the Internet is accessible.

- 32 clock hours (32 hrs lecture and practical exercises, 00 hrs lab-practicum, 00 hrs externship)
- 2.0 Semester Credit Hours
- Prerequisites: None

### **BMT 102 - First Aid/CPR/ARD and Bloodborne Pathogens**

The American Red Cross First Aid/CPR/AED course prepares students with the necessary knowledge and skills to recognize and respond appropriately to cardiac, breathing and first aid emergencies by giving immediate care to suddenly injured or ill person until advanced medical personnel arrive and take over. In the American Red Cross Bloodborne Pathogens course students learn how Bloodborne pathogens are spread, how to prevent exposure incidents using various engineering techniques and hygiene disciplines and how to recognize, report and follow up on exposures to infectious material. The training course combines lecture, discussion, demonstrations, Q&A, and video with hands-on training in a “practice-while-you-watch” format.

- 16 clock hours (16 hrs lecture and practical exercises, 00 hrs externship)
- Number of Semester Credit Hours: None
- Prerequisites: None
- Related Outcomes: After successful completion the student receives three American Red Cross Certificates of Completion for FIRST AID, ADULT CPR/AED and Bloodborne Pathogens.

### **BMT 103 - Fundamentals of Biomedical Equipment Troubleshooting**

This course emphasizes soldering techniques, logical approaches to troubleshooting, the scope and tasks of a preventive maintenance system, and a thorough understanding of the electrical safety in a medical environment. The course also explores applicable NFPA 99, JCAHO, CLIA, FDA and other regulatory agencies and their regulations governing medical equipment in the clinical environment. Case studies are used to provide examples of interpretation and application. The course combines lecture, audio-visual presentations, instructor demonstrations, and laboratory practicums to provide the student with a base of knowledge, skills, and methods used to identify, formulate, and solve critical problems in the field of troubleshooting, repair and preventive maintenance of medical equipment as well as in the field of electrical safety in the medical environment.

- 44 clock hours (24 hrs lecture, 20 hrs lab-practicum, 00 hrs externship)
- 2.5 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102

### **BMT 104 - Physics Engineering: DC Circuits**

This introductory physics course leads the students to the basic concepts and principles of electricity and electric field theory. It also strengthens their understanding through a broad range of applications to the electrical machinery used in biomedical equipment and enables them to develop a systematic and analytical approach to problem solving or troubleshooting. Students are motivated through practical examples that demonstrate the role of physics in disciplines such as biomedical engineering and medicine. The class is conducted primarily through inquiry based laboratory experiments and problem solving activities reinforced with class lecture and discussion. For additional lectures and laboratory practicum, students use the Nida Model 130E Console as the primary platform for electronic experiments performed in a Computer Aided Instruction (CAI) format. This course also emphasizes hands-on experience in troubleshooting electronic circuits. The virtual classroom allows for live interaction between student and the trainer, enabling students to ask questions, take simulations and quizzes. The additional 20 hour – online course is required to be completed from home, or wherever the Internet is accessible. The DC Circuits course combines lecture, audio-visual presentations, instructor demonstrations, online (virtual) classroom and laboratory practicum to provide

the student with a base of knowledge, skills and techniques essential to identify, formulate and solve engineering problems in the field of DC circuits.

- 100 clock hours (68 hrs lecture, 32 hrs lab-practicum, 00 hrs externship)
- 5.0 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103

### **BMT 105 - Physics Engineering: Magnetism and AC Circuits**

This course introduces AC electricity with an emphasis on circuit analysis, measurements and operation of test equipment. Topics include AC principles, circuit analysis laws and theorems, components, test equipment operation, circuit simulation and other related topics. Students perform circuit analysis calculations of voltage, current, resistance, power, inductance, inductive reactance, capacitive reactance, impedance, volt-amps, power factor and phase angle in R-L, R-C and R-L-C series and parallel circuits. Upon completion, students should be able to interpret circuit schematics; design, construct, verify and analyze AC circuits and properly use test equipment. The class is conducted primarily through inquiry based laboratory experiments and problem solving activities, reinforced with class lecture and discussion. For laboratory practicum (experiments), students use the Nida Model 130E Console as the primary platform for electronic experiments performed in a Computer Assisted Instructional (CAI) based curriculum. The virtual classroom allows for live interaction between student and the trainer enabling students to ask questions, take simulations and quizzes. The additional 20 hour – online course is required to be completed from home, or wherever the Internet is accessible. The course emphasizes hands on experience in troubleshooting electronic circuits and combines lecture, audio-visual presentations, instructor demonstrations, online (virtual) classroom, and laboratory practicums to provide the student with a base of knowledge, skills and techniques essential to identify, formulate and troubleshoot electronic AC circuits.

- 60 clock hours (40 hrs lecture, 20 hrs lab-practicum, 00 hrs externship)
- 4.0 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104

### **BMT 106 - Electronic Devices and Circuits**

This course introduces diodes, transistors, operational amplifiers and circuitry using solid state (semiconductor) devices. It focuses on concepts and principles of these fundamental devices and circuits in analog electronics and strengthens the understanding of methods and techniques of troubleshooting electronic devices used in biomedical equipment. The class is conducted primarily through inquiry based laboratory experiments and problem solving activities, reinforced with class lecture and discussion. For laboratory practicum (experiments) students use the Nida Model 130E Console as the primary platform for electronic experiments performed in a Computer Aided Instructional (CAI) format. The virtual classroom allows for live interaction between student and the trainer, enabling students to ask questions, take simulations and quizzes. The additional 20 hour – online course is required to be completed from home, or wherever the Internet is accessible. The course combines lecture, audio-visual presentations, instructor demonstrations, computer aided instruction, online (virtual) classroom, and laboratory practicum to provide the student with a base of knowledge, skills and techniques essential to identify, formulate and troubleshoot electronic circuits.

- 92 clock hours (56 hrs lecture, 36 hrs lab-practicum, 00 hrs externship)
- 5.0 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105

### **BMT 107 - Biomedical Instrumentation, Sensors and Transducers**

This course provides information for the selection, application, calibration and usage of modern transducers and sensors to measure electrical, environmental and dynamic phenomena. It provides a basic understanding of modern instrumentation and measurement systems, where data can be acquired with a speed, volume and accuracy unknown a decade ago. The course alerts the students to the many varieties of instrumentation and transducer systems available, their operating principles, strengths and weaknesses. It also deals with basic

information on selection, application, calibration and usage of modern transducers and sensors to measure bioelectrical, environmental and dynamic phenomena in different medical applications. It educates the students about many transducers available, their operating principles and application information on the ability to select optimum transducer, amplifier, and recording and readout devices to assemble a system for routine measurements of environmental and dynamic phenomena. A variety of measurands and transducer types is covered, as well as signal conditioning, recording and analysis. The associated laboratory correlates theory with practical applications. The course combines lecture, audio-visual presentations, instructor demonstrations and laboratory practicum to provide the student with a base of knowledge, skills and techniques essential to identify, formulate and troubleshoot electronic circuits. This course emphasizes hands on experience in using electrical safety analyzers, multimeters, oscilloscopes and biomedical sensors and transducers.

- 8 clock hours (6 hrs lecture, 2 hrs lab-practicum, 00 hrs externship)
- 0.5 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106

### **BMT 108 - Laboratory Equipment: Clinical Centrifuges**

This laboratory oriented course enables the students to learn engineering, operation and troubleshooting principles of centrifuges used in the health care industry. During training, students become familiar with the principle of operation and clinical applications of various laboratory centrifuges and participate in their preventive maintenance and troubleshooting using appropriate test equipment such as electrical safety analyzers and tachometers. This course emphasizes hands-on experience in installation, operation, routine maintenance, internal components, functional verification testing, calibration and troubleshooting procedures through instructor-induced defects on two different types of clinical centrifuges. The course combines lecture, audio-visual presentations, instructor demonstrations, and laboratory practicums to provide the student with a base of knowledge, skills, and techniques essential to identify, formulate, and solve engineering problems in the field of clinical centrifuges.

- 32 clock hours (18 hrs lecture, 10 hrs lab-practicum, 4 hrs externship)
- 2.0 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107

### **BMT 109 - Aspiration and Suction Devices: Aspirators and Suction Pumps**

This course enables the students to learn the clinical application, engineering, operation and repair principles of aspiration and suction devices in the health care industry. During training, students become familiar with the principle of operation and clinical applications of various suction devices and participate in their preventive maintenance and troubleshooting using appropriate test equipment such as electrical safety analyzers and pressure meters. This course emphasizes hands-on experience in installation, operation, routine maintenance, internal components, functional verification testing, calibration, troubleshooting and preventive maintenance procedures through instructor-induced defects on two different types of suction pumps.

- 32 clock hours (10 hrs lecture, 18 hrs lab-practicum, 4 hrs externship)
- 2.0 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107

### **BMT 110 - Humidity and Aerosol Therapy Devices: Humidifiers, Nebulizers and Medical Compressors**

This course emphasizes on the engineering design, operation and troubleshooting principles of humidity and aerosol therapy devices used in the health care industry. During the training, students learn the principle of operation and clinical applications of most common humidifiers, nebulizers and medical compressors and participate in their preventive maintenance and troubleshooting using the appropriate test equipment such as, electrical safety analyzers and pressure meters. This course emphasizes hands-on experience in installation, set-up, operation, routine maintenance, internal components, functional verification testing, and calibration, troubleshooting and preventive maintenance procedures of several types of humidifiers, nebulizers and



medical compressors. The course combines lectures, audio-visual presentations, instructor demonstrations and laboratory practice to provide the student with a base of knowledge, skills and techniques essential to identify, formulate and solve engineering problems in the field of humidity and aerosol therapy devices.

- 8 clock hours (2 hrs lecture, 2 hrs lab-practicum, 4 hrs externship)
- 0.5 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107, 109

### **BMT 111 - Medical Temperature Measuring Devices: Handheld Digital Thermometers and Temperature Monitoring Sensors**

This course teaches students the principles of medical temperature measuring devices. During training, students become familiar with the clinical use and principle of operation of different types and models of medical thermometers and participate in their preventive maintenance using the appropriate test equipment. This course emphasizes hands-on experience in installation, set-up, operation, routine maintenance, internal components, functional verification testing, calibration, troubleshooting and preventive maintenance of different types and models of medical temperature measuring devices such as clinical thermometers, laboratory thermometers and temperature monitoring sensors. This course also introduces otoscopes and ophthalmoscopes as part of a modern diagnostic system. Through a combination of lectures, audio-visual presentations, instructor demonstrations and laboratory practicums the student will acquire knowledge, skills and techniques essential to identify, formulate and solve engineering problems in the field of thermometers and temperature measuring devices.

- 8 clock hours (5 hrs lecture, 3 hrs lab-practicum, 00 hrs externship)
- 0.5 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107

### **BMT 112 - Infant Care Equipment: Infant Incubators and Warmers**

In this course, students will be trained on the engineering principles of infant care equipment. During training, students become familiar with the clinical use and principle of operation of different models of infant incubators and warmers and participate in their preventive maintenance using appropriate test equipment, such as electrical safety analyzers, gas flow meters, sound meters, calibrated weights and temperature measuring devices. In addition to infant incubators, students will also learn about alternative infant warming devices. This course emphasizes hands-on experience in installation, set-up, operation, routine maintenance, internal components, functional verification testing, calibration, troubleshooting and preventive maintenance of a variety of infant warmers and incubators. Through a combination of lectures, audio-visual presentations, instructor demonstrations and laboratory practice, students will gain knowledge, skills and techniques essential to identify, formulate and solve engineering problems in the field of infant incubators and warmers.

- 16 clock hours (8 hrs lecture, 8 hrs lab-practicum, 00 hrs externship)
- 1.0 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107

### **BMT 113 - Sterilizing Equipment: Steam Sterilizers and Hot Air Ovens**

This course enables the students to learn clinical application, and engineering, operation and troubleshooting principles of various types of sterilizing equipment. During the training, students become familiar with the clinical use and principle of operation of different types of medical sterilizers and participate in their preventive maintenance using the appropriate test equipment such as electrical safety analyzers, and temperature control devices as well as quality control indicators. This course also emphasizes hands-on experience in installation, set-up, operation, routine maintenance, internal components, functional verification testing, and calibration, troubleshooting and preventive maintenance procedures of hot air and steam sterilizers. The course combines classroom and laboratory lectures, audio-visual presentations, instructor demonstrations and practicums to provide the student with a base of knowledge, skills and techniques essential to identify, formulate and solve engineering problems in the field of sterilizing equipment.

- 28 clock hours (14 hrs lecture, 10 hrs lab-practicum, 4 hrs externship)
- 2.0 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107

#### **BMT 114 - Medication Management and Enteral Delivery Systems: General Infusion, Pain Management, Syringe, and Feeding Pumps**

Through a series of lectures, audio-visual presentations, instructor demonstrations and laboratory practicums students learn engineering and design, operation and troubleshooting principles of medication management and enteral delivery systems. During the training, students will become familiar with the clinical use and principle of operation of drug and enteral delivery systems and participate in their preventive maintenance using appropriate test equipment such as electrical safety analyzers, IV pump analyzers and universal biometers. This course emphasizes hands-on experience in installation, set-up, operation, routine maintenance, internal components, functional verification testing, calibration, troubleshooting and preventive maintenance of various medication management and enteral delivery systems.

- 32 clock hours (14 hrs lecture, 14 hrs lab-practicum, 4 hrs externship)
- 2.0 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107

#### **BMT 115 - Hospital Ancillary Equipment: Beds, Tables, Stretchers, and Wheelchairs**

In this laboratory oriented course students learn engineering, design, operation and troubleshooting principles of some ancillary equipment used in medical industry. During training, students become familiar with the clinical use and principle of operation of hospital beds, tables, stretchers and wheelchairs and participate in their preventive maintenance using the appropriate test equipment, such as electrical safety analyzers, weight scales, and universal biometers. This course emphasizes hands-on experience in installation, set-up, operation, routine maintenance, internal components, functional verification testing, calibration, troubleshooting and preventive maintenance of latest technology for medical ancillary equipment.

- 8 clock hours (2 hrs lecture, 6 hrs lab-practicum, 00 hrs externship)
- 0.5 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107

#### **BMT 200 - Cardiac Anatomy and Physiology of the Human Body**

This course teaches human cardiac anatomy and physiology at a level of detail and in a language that is clear and understandable. This course covers the circulatory system, the role of the heart in the body, the cardiac cycle, electrical impulses in heart cells and other necessary principles which prepare students to understand engineering principles involved in designing ECG machines, pacemakers and defibrillators systems. The training course combines lecture, discussion, practicum, Q&A and video presentations. **Key topics:** *the circulatory system, heart, chambers, valves, major vessels, heart muscle, circulation of blood through a heart, pulmonary circulation, heart & lung connections, systemic circulation, heart & body connections, coronary circulation, the cardiac cycle, diastole, systole, the electrical conduction system of the heart, unique qualities of the heart, pathways for conduction, electrical stimulation, sinus and arrhythmia ECG waveforms.*

- 8 clock hours (8 hrs lecture, 00 hrs lab-practicum, 00 hrs externship)
- 0.5 Semester Credit Hours
- Prerequisites: None

#### **BMT 201 - Non-Invasive Blood Pressure & Vital Signs Monitors**

Engineering, design, operation and troubleshooting principles used in the area of vital signs monitoring systems are taught in this course. During the training, students become familiar with the clinical use, principle of operation and the clinical applications of different models and types of non-invasive blood pressure and vital signs monitors. Students will also participate in the preventive maintenance and troubleshooting using

appropriate test equipment, such as non-invasive blood pressure analyzers, electrical safety analyzers, temperature measuring devices and pulse oximetry simulators. This course also lays emphasis on hands-on experience in installation, set-up, operation, routine maintenance, functional verification testing, calibration, troubleshooting and preventive maintenance procedures of various patient monitoring systems used to measure the heart rate, non-invasive blood pressure, temperature and pulse oximetry. Course study includes both class lecture and hands on lab experience.

- 20 clock hours (10 hrs lecture, 10 hrs lab-practicum, 00 hrs externship)
- 1.0 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107, 200

### **BMT 202 - Diagnostic Equipment: Electrocardiograph**

This course enables the students to learn engineering, operation and repair principles of electrocardiographs (also referred to as ECG's or EKG's) in the health care industry. During training, students become familiar with the principle of operation and clinical applications of electrocardiographs and participate in their preventive maintenance and troubleshooting using the appropriate test equipment, such as electrical safety analyzers, patient simulators and other appropriate measuring devices. This course emphasizes hands-on experience in installation, set-up, operation, routine maintenance, internal components, functional verification testing, configuration, calibration, troubleshooting and preventive maintenance procedures of electrocardiographs.

- 28 clock hours (16 hrs lecture, 12 hrs lab-practicum, 00 hrs externship)
- 2.0 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107, 200

### **BMT 203 - Patient Monitoring Systems: Bedside Monitors**

Through a series of lectures, audio-visual presentations, instructor demonstrations and laboratory practicums students learn engineering, design, operation, functional verification and troubleshooting principles of patient monitoring systems. During the training, students will become familiar with the principle of operation and clinical applications of various bedside monitors along with measuring parameters such as heart rate, non-invasive blood pressure, temperature, ECG signals and pulse oximetry, respiration rate, while also participating in the preventive maintenance and troubleshooting using the appropriate test equipment, such as invasive and non-invasive blood pressure analyzers, electrical safety analyzers, temperature measuring devices, pulse oximetry simulators, patient simulators and other measuring devices. This course also emphasizes on hands-on experience in installation, set-up, operation, routine maintenance, internal components, functional verification testing, calibration, troubleshooting and preventive maintenance procedures of various bedside monitors.

- 32 clock hours (14 hrs lecture, 14 hrs lab-practicum, 4 hrs externship)
- 2.0 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107, 200, 201, 202

### **BMT 204 - Cardiology Equipment: Defibrillators**

In this laboratory oriented course students learn engineering, design, operation and troubleshooting principles of defibrillators used in the health care industry. During the training, students will become familiar with the clinical use and principle of operation of different types of defibrillators and participate in their preventive maintenance and troubleshooting using appropriate test equipment such as electrical safety analyzers, defibrillator analyzers, patient simulators, non-invasive pressure simulators and automated biomedical equipment test systems. This course emphasizes hands-on experience in installation, set-up, operation, configuration, routine maintenance, internal components, functional verification testing, calibration, troubleshooting and preventive maintenance procedures of different models of defibrillators. The course combines lecture, audio-visual presentations, instructor demonstrations and laboratory practicums to provide the student with a base of knowledge, skills and techniques essential to identify, formulate and solve engineering problems in the field of defibrillators.

- 32 clock hours (14 hrs lecture, 14 hrs lab-practicum, 4 hrs externship)
- 2.0 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107, 200, 201, 202, 203

### **BMT 205 - Ultrasound Physics, Sensors and Transducers**

This course describes the physics phenomena and transducer technology used in ultrasound image formation through a series of lectures, audio-video presentations and instructor demonstrations that facilitate a thorough understanding of physics and instrumentation in the field of ultrasound imaging modality. The simple qualitative and quantitative explanations using examples and illustrations to convey the science alert the students to the many varieties of ultrasound transducers available and their operating principles. It also gives the students enough application information that they can select optimum transducer to assemble an ultrasound system for specific routine operation procedures. A variety of measurands and transducer types are covered along with signal conditioning, recording and analysis.

- 16 clock hours (16 hrs lecture, 00 hrs lab-practicum, 00 hrs externship)
- 1.0 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107

### **BMT 206 - Vascular/Fetal Doppler Monitoring Systems**

In this course students learn engineering, design, operation and troubleshooting principles in the area of vascular/fetal Doppler monitoring systems. During training, students become familiar with the principle of operation and clinical applications of several models of fetal and vascular/obstetrics monitoring systems and perform functional verifications and systems quality control assessments by using the appropriate test equipment such as electrical safety analyzers, ultrasound mimicking phantoms, ultrasound thickness meters, ultrasound wattmeters, and automated biomedical equipment test systems. This course emphasizes hands-on experience in installation, set-up, operation, routine maintenance, functional verification testing, calibration and troubleshooting of various vascular/fetal Doppler monitoring systems.

- 8 clock hours (4 hrs lecture, 00 hrs lab-practicum, 4 hrs externship)
- 0.5 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107, 205

### **BMT 207 - Imaging Equipment: Ultrasound Systems**

This course introduces students to the field of ultrasound imaging modality with emphasis on engineering principles used in designing the architecture of such complex machines, by describing the main components along with their functions, conventional imaging approaches (2D, M, Doppler, duplex, 3D), various spatial and Doppler measurements, ultrasound artifacts, bioeffects as well as a complete set of quality control procedures used to assess system performance. Students learn how to image different human organ mimicking phantoms as well as performance assurance phantoms. This approach to learning facilitates the students to promptly learn how to operate the ultrasound system, how to better understand the needs of a Sonographer and how to assess ultrasound system performance. During the practicum, students learn principle of operation, clinical applications of various models of ultrasound systems and perform routine/preventive maintenance procedures using appropriate test equipment such as electrical safety analyzers, patient simulators, ultrasound transducer testers, ultrasound wattmeters, various mimicking phantoms, and specific software suites. The course also focuses on equipment installation, set-up, operation and routine maintenance, functional verification testing, troubleshooting and preventive maintenance. Physics, principles of ultrasound, board level theory and system diagnostics are studied to facilitate repair. Hands-on laboratory environment trains students to verify proper equipment operations and teaches diagnostic troubleshooting techniques and quality assurance procedures.

- 64 clock hours (40 hrs lecture, 24 hrs lab-practicum, 00 hrs externship)

- 4.0 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107, 205, 206

### **BMT 208 - Anatomy and Physiology of the Human Respiratory System**

This course teaches the anatomy, organization, phases and disorders of the respiratory system and associated medical terminology. It also introduces the students to respiratory care equipment. The training course combines lecture, discussion, practicum, Q&A and video presentations. **Key topics:** *respiration, phases of respiration, respiratory system, the nasal cavities, pharynx, larynx, trachea, bronchi, lungs, alveoli, lung cavities and pleura, process of respiration, mechanism of pulmonary ventilation, transporting gases in the blood, gas exchange, transport of oxygen, transport of carbon dioxide, regulation of respiration, nervous and chemical controls of respiration, abnormal ventilation, breathing patterns, disorders of the respiratory system, physical properties of matter, the gas laws, fluid mechanics.*

- 8 clock hours (8 hrs lecture, 00 hrs lab-practicum, 00 hrs externship)
- 0.5 Semester Credit Hours
- Prerequisites: None

### **BMT 209 - Oxygen Supply Systems: Oxygen Concentrator**

In this laboratory oriented course students learn engineering, operation and troubleshooting principles used in the area of oxygen concentrators. During the training, students become familiar with the clinical applications and principle of operation of different models of oxygen concentrators and participate in their preventive maintenance and troubleshooting using the appropriate test equipment such as, electrical safety analyzers, gas flow meters, oxygen analyzers and automated biomedical equipment test systems. This course also emphasizes hands-on experience in installation, set-up, operation, routine maintenance, internal components, functional verification testing, calibration, troubleshooting and preventive maintenance procedures of oxygen concentrators. The course combines lectures, audio-visual presentations, instructor demonstrations and laboratory practicum to provide the student with a base of knowledge, skills and techniques essential to identify, formulate and solve engineering problems in the field of oxygen concentrators.

- 8 clock hours (4 hrs lecture, 4 hrs lab-practicum, 00 hrs externship)
- 0.5 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107, 200, 208

### **BMT 210 - Respiratory Care Equipment: Ventilators**

This course covers engineering principles currently adopted in modern ventilator technology, technical operation and physical functions of ventilator components, fluidics and graphics as well as the specific functions of high-frequency ventilators. During training, students become familiar with the clinical use and principle of operation of ventilators and participate in their preventive maintenance using appropriate test equipment, such as electrical safety analyzers, lung testers, gas flow meters and gas analyzers. This course emphasizes hands-on experience in installation, set-up, operation, routine maintenance, internal components, functional verification testing and calibration, troubleshooting and preventive maintenance procedures for pediatric and adult ventilators. The course combines lecture, audio-visual presentations, instructor demonstrations and laboratory practicum to provide the student with a base of knowledge, skills and techniques essential to identify, formulate and solve engineering problems in the field of ventilators.

- 24 clock hours (12 hrs lecture, 8 hrs lab-practicum, 4 hrs externship)
- 1.5 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107, 200, 208, 209

### **BMT 211 - Ancillary Equipment for Clinical Laboratory**

This course introduces the students to the field of ancillary equipment used in a clinical laboratory. During the training, students become familiar with the principle of operation and clinical applications of various ultrasonic

cleaners, lab incubators, dry baths, water baths, shakers/rockers, and magnetic stirrers. This course emphasizes hands-on experience in installation, set-up, operation, routine maintenance, functional verification testing, calibration and troubleshooting of a large variety of ancillary equipment found in a typical clinical laboratory.

- 8 clock hours (4 hrs lecture, 00 hrs lab-practicum, 4 hrs externship)
- 0.5 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107, 108

### **BMT 212 - Fundamentals of Spectrophotometry and Clinical Chemistry Instrumentation**

“Fundamentals of Spectrophotometry” is the first in a series of courses designed to introduce students to the topics of chemical detection and measurement used in clinical chemistry instrumentation. This course introduces the fundamental principles of UV/VIS/IR spectrophotometry, chemical measurement used in medical diagnosis, quality assurance and control, and research studies. The students learn how to perform analytical procedures using UV/visible spectrophotometry. Throughout this course, there is a strong emphasis on good laboratory practices (GLP), error analysis and the correct use of statistics, and problem-solving skills. During the second part of the course – “Clinical Chemistry Instrumentation” – students learn the clinical use and operating principles of several types and models of clinical chemistry analyzers while also participating in the troubleshooting and preventive maintenance sessions by using the appropriate test equipment. The course provides the basic techniques involved in analyzing blood samples leading to a better understanding of the physics, the instrumentation and the needs of the biochemistry technologist. Students also learn how to assess system performance using calibrators and standards. The course focuses primarily on equipment installation, set-up, operation, routine maintenance, internal components, functional verification testing, calibration, troubleshooting and preventive maintenance procedures. Physics, clinical chemistry principles, board level theory and system diagnostics are studied to facilitate repair. A hands-on laboratory environment trains students to verify proper equipment operations and teaches diagnostic troubleshooting techniques and quality assurance procedures. The course combines lectures, audio-visual presentations, instructor demonstrations and laboratory practicum to provide the student with a base of knowledge, skills and techniques essential to identify, formulate and solve engineering problems in the field of clinical chemistry.

- 40 clock hours (28 hrs lecture, 12 h lab-practicum, 00 hrs externship)
- 2.5 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107, 108, 211

### **BMT 213 - Laboratory Equipment: Microscopes**

This course introduces the students to the basic principles of clinical microscopy. During training, students become familiar with the principle of operation and laboratory applications of different models of microscopes and participate in their preventive maintenance by using appropriate test equipment. This course emphasizes hands-on experience in installation, operation, routine maintenance, functional verification testing and calibration, as well as troubleshooting a variety of different models of microscopes.

- 8 clock hours (5 hrs lecture, 3 hrs lab-practicum, 00 hrs externship)
- 0.5 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107, 108

### **BMT 214 - Introduction to Hematology Instrumentation**

During this course students learn the clinical use and operating principles of several models of hematology analyzers and participate in their preventive maintenance and troubleshooting sessions using appropriate test equipment. The course provides the basic technique involved in analyzing blood samples leading to a better understanding of the physics, instrumentation and the needs of a hematology technologist. Students also learn how to assess system performance using blood calibrators and standards. The course focuses primarily on equipment installation, set-up, operation, routine maintenance, internal components, functional verification testing, calibration, troubleshooting and preventive maintenance procedures. Physics, cell sizing and counting

principles, board level theory and system diagnostics are studied to facilitate repair. A hands-on laboratory environment trains students to verify proper equipment operations and teaches diagnostic troubleshooting techniques and quality assurance procedures. The course combines lectures, audio-visual presentations, instructor demonstrations and laboratory practicum to provide the student with a base of knowledge, skills and techniques essential to identify, formulate and solve engineering problems in the field of hematology.

- 16 work hours (12 hrs lecture, 4 hrs lab-practicum, 00 hrs externship)
- 1.0 Semester Credit Hours
- Prerequisites: BMT 100, 101, 102, 103, 104, 105, 106, 107, 108, 211, 212, 213