



# CANADA COLLEGE

## Diploma in Clinical Engineering

**Diploma:** Minimum 36 credits are required.

**Registration fee:** \$50.00

**Tuition fee:** \$ 16000.00

### Clinical Engineer

**Clinical Engineers are the professionals that are responsible for patient related hospital equipment service and support. They promote patient care by applying technical skills to healthcare technology.**

**Clinical Engineer inspect, maintain, repair, calibrate and modify instruments and equipment used in medical therapy, diagnosis and research. Technicians may be involved in equipment operation, supervision and control. Depending on their specialty they:**

- **Install, inspect, maintain and test electronic, electrical, mechanical, hydraulic and pneumatic equipment and instruments.**
- **Disassemble equipment to locate malfunctions and repair or replace defective parts.**
- **Reassemble equipment and adjust precision components according to blueprints and written and verbal instructions.**
- **Perform safety checks on electrical and radiation equipment.**
- **Add to or change components to meet specific therapeutic or diagnostic requirements.**
- **Train people to operate equipment safely.**
- **Maintain supply inventories and parts and reorder items as needed.**

- **Repair and maintain equipment used in radiology, nuclear medicine and patient-monitoring operations, or airborne biomedical instrumentation.**
- **Biomedical Engineering Technicians design, construct, develop, install and service biomedical and related equipment.**

**Most Clinical Engineers work in hospitals and large clinics with other technicians and hospital or clinic personnel, or with biomedical or clinical engineers and scientists. Some work for manufacturers in engineering, sales or service.**

## **Educational Requirements:**

**Students interested in becoming Biomedical Equipment Technicians/Clinical Engineer should prepare by taking challenging high school courses in science, math, and electronics. Employers often hire and train individuals who have a background in electronics, however, some prefer graduates of formal biomedical equipment technology programs.**

**Student residing outside Canada may find a hospital to spend their internship part of this program. A communication between Canada College of Education and the hospital will be conducted in order to facilitate student entry in the internship program. The duration of this internship will be two months.**

### **Biomedical Professional Ethics**

Professional Ethics are well documented, but are rarely made more specific for a particular profession. One exception is in the health profession, in almost every area of this profession has a detailed code of ethics, basic ideals for which all members are expected to strive for. Clinical Engineering is no exception.

**Accurately represent your level of responsibility, authority, experience, knowledge, and education.**

- **Strive to prevent a person from being placed at risk due to the use of technology.**
- **Reveal conflicts of interest that may affect information provided or received.**
- **Respect the confidentiality of information**
- **Work toward the improving the delivery of health care.**
- **Work toward the containment of cost by the better management and utilization of technology.**

**Promote the profession of clinical engineering**

## **Course Descriptions:**

### **BME 202 Medical Instrumentation I (3, 3)**

An introduction to the principles of operation and the clinical application of medical instrumentation. Emphasis is placed on the electronic principles used in health devices including amplifiers, signal conditioning and power supplies. The integration of physics, chemistry, electronics and medicine in medical devices is examined. Hospital organization and the legal aspects of medical device repair are studied. Laboratory work includes experiments in electronics; medical equipment operation, preventive maintenance and repair.

### **BME 203 Medical Instrumentation II (3, 4)**

A continuation of Medical Instrumentation I. Emphasis is placed on the operation of more sophisticated medical devices and systems; particularly those which are computer or microprocessor based. Laboratory work includes inspection and repair procedures for various types of equipment similar to that commonly found in operating rooms, intensive care units, clinical laboratories and various clinical diagnostic units.

### **BME 254 Electronic Health Care Systems (BMET Clinical Internship) (1, 2)**

Application of the principles learned in BME 202 and BME 203. Students work in a local hospital under the direct supervision of an experienced BMET or Clinical Engineer. Emphasis is on the use of principles learned in lecture and laboratory to actual clinical situations.

### **BM 500 Hospital Clinical Engineering and Management (3+0+0)**

Principles of Clinical Engineering. Hospital Organization. Procurement policies. Setting up a Clinical Engineering Department. Maintenance Program.

### **BM 501 Introduction to Biological Systems (3+0+0)**

Diffusion and osmosis. The Donnan equilibrium. pH and buffers. Passive and active transports. Phospholipids. Aminoacids and proteins.

### **BM 502 Introduction to Physiology (4+0+0)**

Basic anatomy. Transport through the cell membranes. Homeostatics. The anatomy of the heart, the electrocardiogram. Physics of systemic and lymphatic circulation. The anatomy of kidneys, glomerular and tubular filtrations, the body fluids. The anatomy of respiratory system, pulmonary ventilation, physical principles of gaseous exchange. The anatomy of digestive system, digestion and absorption in the gastrointestinal tract. Introduction to endocrinology. The anatomy of the reproductive systems, sexual functions and hormones, pregnancy and lactation.

### **BM 510 Biomedical Instrumentation Laboratory I (0+0+2)**

Electrical safety testing, infusion pump testing, defibrillators, biopotential amplifier, oxygen analyzer and monitor, cardiac output measurement by thermodilution, electrosurgical unit testing, electronic clinical thermometer, ultrasound power measurements, blood pressure monitoring.

### **BM 511 Lasers in Biomedicine (3+0+0)**

Operation principles of different lasers. Nd-YAG and CO<sub>2</sub> Lasers. Laser surgery: the CO<sub>2</sub> Laser in neuro-surgery, endoscopic high power Nd-YAG laser for control of acute gastrointestinal hemorrhage; ophthalmic uses of lasers. Laser safety.

### **BM 512 Biomedical Instrumentation Laboratory II (0+0+2)**

Respiratory function measurements, the electrocardiogram, heart sounds, Korotkoff sounds, ECG and pulse; Filtering and signal averaging for physiological signals, the X-Ray machine. Galvanic skin response and electroencephalogram. Cardiovascular system dynamics, electromyogram.

### **BM 513 Fundamentals of Electric Circuits (4+0+0)**

Basic physical systems and fundamental quantities. MKSA units. Voltage, current and resistance. Ohm's Law, KVL, KCL. Electrical power, energy and efficiency. Sources and waveforms. Linear resistive networks. Magnetic fields. Magnetic circuits. Magnetic induction. Capacitance, inductance and transformers. Response of RC, RL and RCL networks. Linear system response: Complex numbers and complex frequencies. Fourier series. Laplace and Fourier transforms. Characterization of linear systems. Input / output characterization, the system function, state variables. Complex impedance's. Frequency response in linear systems. Phase-magnitude plots. Resonant circuits.

### **BM 514 Introduction to Electronic Circuits (3+0+0)**

Electrical conduction processes. Diode circuits and applications. Physical electronics of transistors. Large signal transistor circuits. Small signal circuits. Operational amplifiers. Instrumentation applications. Noise, interference and shielding. Filters. Digital circuits and applications. Analog and digital conversions. Introduction to signal processing. Modulation and detection.

### **BM 521 Biosystems and Biomechanics (3+0+0)**

Mechanical properties and constitutive equation. Response of living tissues to prolonged load application. Dynamics of muscle and joints. Biorheology of physiological fluids. Spatial models of physiological systems.

### **BM 523 Biomechanics of Musculoskeletal Systems (3+0+0)**

Structures of the musculoskeletal systems. Mechanical properties of musculoskeletal tissues. Understanding of the mechanical behavior of tissues. Mechanics of major joints of the musculoskeletal systems. Anatomic overview of musculoskeletal joints.

### **BM 524 Applied Biomechanics (3+0+0)**

Applications of principles of mechanics to some specific problems in Biomechanics.

Discussion of solutions offered for the biomechanical problems in Clinical, Orthopedic, Rehabilitation, Occupational and Sports Biomechanics, Kinesiology, Gait Analysis, Implant Biomechanics, Biomaterials.

#### **BM 541 Biological Materials (3+0+0)**

Relationships between materials science and medicine. Properties of crystalline and noncrystalline materials. Principles in strength of materials. Natural biological materials. Artificial biological materials. Applications of materials science to orthopedic surgery. Cardiology and materials science. Applications of materials science research methods to medicine.

#### **BM 542 Prosthetics and Artificial Organs (3+0+0)**

Body segments kinetics. Lower, upper limb prostheses: functional requirements, design criteria, alignment. Control, body powered prostheses. Implanted artificial joint: Joint pathologies, tissue reaction to implants, types and failures of implanted joints, body implants, heart valves, blood vessels, bones and joints, blood oxygenators and blood pumps, heart assisted devices, artificial heart, pancreas and kidney.

#### **BM 551 Biomedical Instrumentation I Measurements (3+0+0+)**

Introduction to Biomedical Engineering and the physical system of the human body. Instrumentation systems; Grounding and safety; Physiological sensors and transducers; Amplifiers used in biomedical instrumentation; Recorders and display devices; Electrocardiograph, Electroencephalograph, Electromyography (ECG, EEG, EMG), Blood pressure and flow measurements, Cardiac output measurements.

#### **BM 552 Biomedical Instrumentation I Measurements II (3+0+0+)**

Instrumentation for the clinical laboratory. X-Rays and Radioisotope instrumentation systems; Ultrasonic; thermography; Computerized Tomography; NMR techniques; Lasers; Fiber optics. Data processing and transmission.

#### **BM 571 Biomedical Signal Processing (3+0+0)**

Discrete-time signals and systems. Sampling, bandwidth and aliasing, convolution, recursive and non recursive difference equations, frequency response. The z-transform and its extensions. Discrete Fourier transform, circular convolution, expansion, Fast Fourier Transform (FFT) algorithms. Spectral analysis and detection. Digital and adaptive filter algorithms. Applications; processing of bioelectric signals; image and speech processing, estimation of echoes.

#### **BM 580 Electrical Impedance Tomography (3+0+0)**

Electrical impedance of tissues and detection of physiological events; electrodes; principles of electrical impedance tomography; EIT instrumentation; data collection methods and data collection errors; electrical safety; interfacing and computers; mathematical preliminaries; finite-element method; reconstruction algorithms; computational complexity; comparison of reconstruction techniques; biological tissue characterization clinical applications.

**BM 581 Bioelectronic Instrumentation and Measurements (3+0+0)**

Introduction to Biomedical Engineering and the physical system of the human body. Medical instrumentation sensors, electrodes and transducers; Electrocardiography, Electroencephalography, Electromyography, Electroretinography, (ECG,EEG,EMG,ERG) Blood pressure and flow measurement; Respiratory measurement. Concepts for intensive care units. Electrical safety in hospitals.

**BM 582 Principles of Medical Imaging Systems (3+0+0)**

Radiation quantities and units; radioactivity; X-ray production and X-ray tube; interaction of radiation with matter, scattered radiation; X-ray film; fluoroscopy; digital imaging system; ultrasound imaging; Gamma camera; X-ray CT; emission tomography: PET and SPEC; Ultrasound tomography; NMR imaging; patient exposure and protection; quality assurance in x-ray equipment; Lasers in medicine.

P.O.Box 633, Stn. H, Montreal, Quebec, H3G 2M6 Canada. Tel: 514-868-6262, 514-994-7976, 514-935-3106, Fax: 514-868-0869. [www.collegecanada.com](http://www.collegecanada.com)  
apply@collegecanada.com

**Admission Office:** 1118 Sainte Catherine West, # 405, Montreal, Quebec H3B 1H5, Canada