Engineering Program

Specialization	**Medical Equipment Maintenance**
Course Number	**20409221**
Course Title	**Microprocessor practice**
Credit Hours	**2**
Theoretical Hours	**1**
Practical Hours	**3**

Brief Course Description:
Microprocessor Practice
Microprocessor architecture, memories ,basic registers, introduction to assembly language and C, interrupters, seven segment, liquid crystal display, dot matrix, applications and simulation.

Course Objectives:

The objective of this course is to introduce the fundamental principles of microprocessors theory and to apply them to the design practical circuits of microprocessors. Different types of microprocessors (ATmega8535of AVR series, 89S51 from ATEML) and their applications will be introduced, with focus on compilers, architecture, memories, interrupters, timing, oscillations, and block diagram.

Detailed Course Description:

Chapter No.	Name of chapter	contents	Duration times
one	**Microprocessor 89S51**	1. Features 2. Pin out, Block Diagram 3. Pin Description 4. Memory Structure 5. SFR 6. Timing 7. Program Counter (PC) 8. Oscillation 9. Reset 10. Power Save Mode 11. I/O Port 12. Interrupt 13. Serial Port Function **14.** Review of c language& Compiler **.**	**Four weeks**
two	**Microprocessor** ATmega8535	1. Features 2. Pin out 3. Block Diagram 4. Internal Structure, Memories 5. Lock Bit 6. fuse bit 7. Signature Byte 8. I/O Port 9. Compiler.	**Three weeks**
Three	CPE-MP100 Practice	1. Device Configuration& Preparation for Use 2. Experiment, Practice: ● LED ● 7-Segment ● Dot Matrix ● Character LCD ● Key Scan ● Digital Code ● Dip S/W&Toggle S/W ● ADC**&**DAC ● USART Communication ● Relay**.**	**Eighth weeks**

Evaluation Strategies:

Exams		Percentage	Date
Tasks , reports& activities		40%	
Mid		20%	
final		40%	
Total		100%	

Teaching Methodology:

- Lectures
- Practice on kits
- PowerPoint

Text Books & References: Experimental Book Micro Computer Training Kits CPE-MP100 **from CHUNGPA**

Textbook:

References:

1. Introduction to microprocessors software, hardware, programming. Lance A Leventhal

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Engineering Program

Specialization	**Medical equipment Maintenance**
Course Number	**20409131**
Course Title	**Physiology & Anatomy**
Credit Hours	**2**
Theoretical Hours	**2**
Practical Hours	**0**

□ **Brief Course Description:**

The human Healthy is the main target for the medical process (patient, doctor (User), Medical Equipment). This course describes the human Body Cellular physiology & its types, the tissues & its types, the Organs & its functions, the Human Body Systems, the human body development, the blood…

□ **Course Objectives:**

Upon the completion of the course, the student will be able to:

1- Overview physiology and anatomy subject.
2- Study the structure of the human body.
3- Explain the work of the human body organs, and the relations between them.
4- Explain the human systems functions.
5- Distinguish the organs, tissues, and systems of human body.
6- Study the circulation system: Blood types and their functions.

Detailed Course Description:

Unit. No.	Content	Notes	Pages	Time Needed
1.	**Cellular Physiology:** Overview of the cellular bases of life. • The fluid membrane structure: - Specialization of plasma membrane. • The Plasma membrane Functions: • The cytoplasm: - Cytoplasmic Organelles. • The Nucleus.			week
2.	**Tissues**: **Overview** • Epithelial tissue. • Connective tissue: types. • Nervous tissue. • Muscle tissue.			week
3.	**The Integumentary System:** • The Skin: Dermis, Epidermis. • Appendages of the skin. • Functions of the Integumentary System: Protection, Body Temperature, Cutaneous Sensation, Blood reservoir, Excretion.			week
4.	**Bones & Skeletal tissues: Overview** • Bones basic structure. • Skeletal cartilages: Basic structure, types, locations. • Major skeletal bones of the body. • Functions of bones and joints.			week
5.	**The Muscular System:** • Introduction in muscle and muscles tissues: Muscles types, Functions. • Major Skeletal Muscles of the body.			week
6.	**Fundamentals of the nervous system** • Overview of the nervous system • Organization of the Nervous system. • Neurophysiology: Basic principles of electricity. • Organization of neurons. The Central Nervous System: • The Brain: Regions and organization of the brain, the cerebral Hemispheres, and the brain stem, cerebellum, Functional brain systems. • The spinal Cord: Cross sectional anatomy. The Peripheral Nervous system • Cranial Nerves. • Spinal Nerves.			week

7.	**The Special Senses:** • Smell & Taste. • The eye and vision. • The ear: Hearing & Balance.			week
8.	**The Endocrine System:** • An Over view. • Major Endocrine Organs. • Hormones.			week
9.	**Blood**: • Blood Composition & Functions: RBC, WBC, Platelets. • Blood Plazma. • Transfusion of Red Blood Cells.			week
10.	**The Cardiovascular system (overview)** The Heart: • Heart anatomy. • Properties of cardiac muscle fibers. • Heart physiology. • Electrical activity of the heart. Blood Vessels: Overview of the vessels: Function & Structure. • Structure of Blood vessels walls. • Arterial System. • Capillaries. • Venous System. Physiology of Circulation: • Blood Pressure, blood flow. • Systemic blood pressure. Circulatory Paths: • The tow main circulations of the body			week
11.	**The Respiratory System:** • Functional anatomy of the respiratory. • Breathing. • Gas Exchanges in the body. • Transport of respiratory gases by blood.			week

12.	**The Digestive System:** **Overview of the digestion system.** • Functional anatomy of the digestion system. • Digestive system Organs: Relationship & structural Plan. • The Stomach. • The Small intestine and associated structures. • The large intestine. • Absorption.			week
13.	The Urinary System: • Kidney anatomy. • Kidney physiology: Mechanisms of Urine formation. • Ureters. • Urinary Bladders. • Urethra.			week

Evaluation Strategies:

		Percentage	Date
1. Exams	First Exam.	20%	--/--/----
	Second Exam	20%	--/--/----
	Final Exam	50%	--/--/----
2. Homework and Projects		10%	
3.Discussions and lecture Presentations			

□ **Teaching Methodology:**

1. Lectures

□ **Text book**:

□ **References** :

- **Human Anatomy & Physiology. Elaine N.Marieb,R.N.,Ph.D. Holyoke Community Collage. Katja Hoehn, M.D., ph.D. Mount Royal College. 7th Edition.** Benjamin Cummings. 2007.
- **Fundamentals of physiology A human persective., Lauralee Sherwood. Department of physiology, School of medicine, West Virginia University. Second Edition.** West publishing company.1992.

Engineering Program

Specialization	**Medical equipment Maintenance**
Course Number	**20409247**
Course Title	**Medical Equipment**
Credit Hours	**2**
Theoretical Hours	**2**
Practical Hours	**0**

□ **Brief Course Description:**

This course covered the bioelectric amplifiers, electrodes and transducers, Diagnostic equipment, principles, functions, factors, diagrams, and other related: electrocardiography, pressure measurements, cardiac output measurements, cardiac stimulation, and electroencephalography, and other Diagnostic Equipment.

□ **Course Objectives:**

Upon the completion of the course, the student will be able to:

1- Study the basic theories of measurements.
2- Explain the bioelectric amplifier work.
3- Study the electrodes and transducers.
4- Distinguish the diagnostic medical equipments.
5- Focus on diagnostic equipments; because it's the important step for the doctor to find the fit treatment.
6- Study the cardiac, monitors, audiometers.
7- Explain how to take care for him self, patient& the instrument.

Detailed Course Description:

Unit. No.	Content	TEXT BOOK	Time Needed (Hours)
1.	**Basic Theories of measurements:** • Categories of measurement: Direct measurement, indirect measurement, Null measurement. • Factors in making measurements: Error, validity, Readability, repeatability, Accuracy, Precision, resolution, offset, linearity, response time, Dynamic linearity. • Measurement errors: Dynamic error, instrument insertion error, Static error, theoretical error. Operational definitions in measurement	Introduction to Biomedical Equipment Technology. Joseph J.Carr, John M. Brown, Prentice Hall, 2001.	5
2.	**Bioelectric signals & electrodes:** • Origin of bioelectric signals. • Electroencephalogram (EEG) signal. • Electromyogram (EMG) signal. • Recording electrodes • Silver-Silver Chloride electrodes. • Electrodes for ECG. • Electrodes for EEG. • Electrodes for EMG. • Electrical Conductivity for electrode Jellies &creams. • Microelectrodes.	Biomedical Instrumentation Technology & Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	5
3.	**Biomedical Recorders:** • Electrocardiograph (ECG). • The ECG Leads. • Microprocessor based ECG Machines. • Multi-channel ECG Machines.	Biomedical Instrumentation Technology & Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	5

	• Types of defibrillator damage. • Electrosurgary Unit filtering. • ECG readout devices • ECG Machines. • Victorcardiograph (VCG). • Phonocardiograph. (PCG). • Electroencephalograph (EEG): Description & Block Diagram, recording of evoke potentials. • Computerized Analysis of EEG. • Electromyograph (EMG). • Other biomedical recorders: Apexcardiograph, Ballistocardiograph (BCG), Electro-oculograph (EOG), Electroretinograph (ERG). • Bio-feed back instrumentation.		
4.	**Patient Monitoring Systems:** • Cardiac Monitor. • Bedside patient monitoring system • Central Monitors. • Measurement of heart rate. • Measurement of pulse rate. • Blood pressure measurement. • Measurement of temperature. • Measurement of respiration rate. • Catheterization laboratory instrumentation. • Plethysmography. • Phonocardiography. • The heart revisited. • Defibrillators. • Heart Lung machines. • Pacemakers.	Biomedical Instrumentation Technology & Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	5
5.	**Arrhythmia & Ambulatory Monitoring Instruments:** • Cardiac Arrhythmias. • Arrhythmia Monitor.	Biomedical Instrumentation Technology & Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	5

	• QRS Detection Techniques. • Exercise Stress Testing: Treadmill test, Bicycle test. • Ambulatory Monitoring Instruments: Data recording, Data Reply and analysis		
6.	**Biomedical Telemetry & Telemedicine:** • Wireless telemetry. • Single Channels telemetry systems. • Multi-channel wireless telemetry systems. • Multi-patient telemetry. • Implantable telemetry system. • Telemedicine.	Biomedical Instrumentation Technology & Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	5
7.	**Oximeters**: • Oximetry. • Ear Oximeter. • Pulse Oximeter. • Skin Reflectance Oximeter. Intravascular Oximeter.	Biomedical Instrumentation Technology & Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	3
8.	**Blood Flow meters:** • Electromagnetic Blood Flow meter. • Types of Electromagnetic Blood Flow meters. • Ultrasonic Blood Flow meters. • NMR Blood Flow Meter. Laser Doppler Blood Flow Meter.	Biomedical Instrumentation Technology & Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	3
9.	**Pulmonary Function Analyzers:** • Pulmonary Function Measurements. • Spirometry. • Pneumotachometers.	Biomedical Instrumentation Technology & Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	5

	• Measurement of volume. • Pulmonary Function Analyzers. • Respiratory Gas Analyzers: IR Gas Analyzer, paramagnetic oxygen analyzer, polarographic oxygen analyzer, thermal conductivity analyzers, N2 Analyzer on ionization technique.		
10.	Audiometers & Hearing Aids: • Mechanism of Hearing: review. • Basic Audiometer. • Pure Tone Audiometer. • Speech Audiometer. • Bekesy Audiometer system. • Evoked Response Audiometry system. • Calibration Of audiometers. • Hearing Aids.	Biomedical Instrumentation Technology & Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	5
11.	**Patient Safety:** • Electric Shock Hazards. • Leakage Currents. • Safety Codes for electro medical equipments. • Electrical Safety analyzer. • Testing Of Biomedical equipment.	Biomedical Instrumentation Technology & Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	4

Evaluation Strategies:

		Percentage	Date
1. Exams	First Exam.	20%	--/--/----
	Second Exam	20%	--/--/----
	Final Exam	50%	--/--/----
2. Homework and Projects		10%	
3.Discussions and lecture Presentations			

□ **Teaching Methodology:**

1. Lectures

□ **Textbook**:

Biomedical Instrumentation Technology & Applications. R.S. Khandpur, McGraw Hill, New York, 2005.

□ **References** :

1. Medical Devices & Systems. Joseph D. Bronzino. Taylor & Francis, 3rd Edition, USA, 2006.

2. Introduction to Biomedical Equipment Technology. Joseph J.Carr, John M. Brown, Prentice Hall, 2001

Engineering Program

Specialization	**Medical Equipment Maintenance**
Course Number	**20409248**
Course Title	**Medical Equipment Workshop**
Credit Hours	**2**
Theoretical Hours	**0**
Practical Hours	**6**

□ **Brief Course Description:**

Work shop in support of the **Medical Equipment** course**.** The practical rules needed to save human, devices, and places. Using Catalogue, Operating Manual, and Service Manual. Install and Reinstall medical equipment and solve problems for diagnostic equipment.

□ **Course Objectives:**

Upon the completion of the course, the student will be able to:

1- Learn the safety factors in the workshop and how to save both the human and equipments.
2- Learn how using the Catalogue, operating, and service manuals.
3- Solve problems for diagnostic medical equipments (ECG, Pressure meter, oximeter, EEG...etc).
4- Solve problems for Monitors, Pulmonary Function Analyzers, Audiometers, Telemetry systems.
5- Classified the equipments by using Serial Number, Model, and Manufacture.

□ **Detailed Course Description:**

Unit. No.	Content	Notes	Time Needed
1.	Electrocardiograph (ECG).		(1 Week)
2.	Electroencephalography (EEG).		(1 week)
3	Electromyogram (EMG).		(1 week)
4	Blood Flow meters: Electromagnetic, Ultrasonic, Laser Doppler.		(2 weeks)
5	Oximeter.		(1 week)
6	Patient Monitoring Systems.		(2 week)
7	Foetal Monitoring Instruments.		(1 week)
8	Telemetry system.		(1 week)
9	Pulmonary Function Analyzers: Spirometer, Respiratory Gas Analyzers.		(3 weeks)
10.	Audiometer.		(2 weeks)

Evaluation Strategies:

		Percentage	Date
1. Exams	Assignments	30%	--/--/----
	Midterm Exam	20%	--/--/----
	Final Exam	50%	--/--/----
2. Homework and Projects			
3.Discussions and lecture Presentations			

□ **Teaching Methodology:**

1. Workshop

□ **Textbook**:

□ **References** :
Service, Maintenance and operating manuals of manufacturing companies.

Engineering Program

Specialization	**Medical Equipment Maintenance**
Course Number	**20409241**
Course Title	**Medical Treatment Equipment**
Credit Hours	**2**
Theoretical Hours	**2**
Practical Hours	**0**

□ **Brief Course Description:**

Treatment Equipments, principles, functions, factors, diagrams, and other related: This course discus the medical treatment Equipment: respiratory instruments, therapeutic and prosthetic devices, Physiotherapy Equipment, Laser therapy, Hemodialysis machine, Electrosurgical unit, Defibrillator, anesthesia machine, Automatic Drug Delivery System, and Operating rooms.

□ **Course Objectives:**

Upon the completion of the course, the student will be able to:

1- Explain the work functions for: defibrillator, electrosurgical unit**,** pacemakers, Stimulators, therapeutic and prosthetic devices, Physiotherapy Equipment, Laser applications, ventilator, anesthesia machine, lithotripters, and Automatic Drug Delivery System.
2- Study the diagram of the Hemodialysis machine.
3- Study the diagram of ventilator machine.
4- Study the diagram of the anesthesia machine.
5- Discus the operating room.

Detailed Course Description:

Unit. No.	Content	TEXT BOOK	Time Needed
1.	**Cardiac Pacemakers:** • Need for Cardiac pacemakers. • External Pacemakers. • Implantable pacemakers • Indications. • Pulse generators. • Sensing circuit. • Output circuit. • Timing circuit. • Power source. • Leads. • Programmers. • System operation. • Clinical outcomes & Cost implications.	Biomedical Instrumentation Technology Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	2
3.	**TENS FES for Ambulation: (The Parastep system):** • The Parastep system: Systems electric charges & charge density parameters, Parameters of stimulation signals & safety stander constrains, System parameters & design, Pulse width & pulse repetition-Rate (Frequency), Stimulation sites. • Patient admissibility, Contraindications & Training.		2
3.	**Cardiac Defibrillators:** • Mechanism of fibrillation. • Mechanism of defibrillation. • DC Defibrillator.	Biomedical Instrumentation Technology Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	2

	• Clinical Defibrillators. • Electrodes. • Synchronization. • Automatic External Defibrillators. • Implantable defibrillator. • Pacer-Cardioverter defibrillator. • Defibrillator safety.		
4.	**Instruments for Surgery:** • Principles of Surgery Diatherm. • Surgical Diathermy Machine: Automatic electrosurgical systems, Electrosurgery techniques, Electrodes used with surgical diathermy. • Safety aspects in Electrosurgical Units. • Surgical Diathermy Analyzers. • Monopolar Mode. • Bipolar Mode. • ESU Hazards.	Biomedical Instrumentation Technology Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	4
5.	**Laser Applications in Biomedical Fields:** • The Laser: Principles Operation Of laser, Types of Lasers. • Pulsed Ruby Laser. • ND-YAG Laser. • Helium-Neon Laser. • Argon Laser. • Co2 Laser. • Excimer Lasers. • Semiconductor Lasers. • Laser Safety.	Biomedical Instrumentation Technology Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	4
6.	**Physiotherapy & Electrotherapy Equipment:** • Short Wave Diatherm. • Microwave Diatherm. • Ultrasonic Therapy Unit. • Electrodiagnostic/Therapeutic	Biomedical Instrumentation Technology Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	4

	Apparatus: Electrodiagnosis, Electrotherapy, Type of apparatus, Functional block diagram description, Interferential current therapy, Pain reliefs throw electrical stimulation: TENS, Spinal Cord Stimulator, Magnetic stimulation. • Diaphragm Pacing by radio-frequency for the treatment of chronic ventilatory insufficiency. • Bladder stimulators.		
7.	**Ventilators:** • Mechanics of respiration (Review). • Negative-Pressure ventilators. • Positive -Pressure ventilators. • Ventilation Modes: Mandatory ventilation, Spontaneous ventilation, Continuous positive airway pressure (CPAP) in spontaneous mode. • Breathe delivery Control. • Types of ventilators. • Ventilator terms. • Classification of ventilators. • Pressure volume flow diagrams. • Modern ventilators. • High frequency ventilators. • Humidifiers, Nebulizers and aspirators.	Biomedical Instrumentation Technology Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	4
8.	**Anesthesia Machine:** • Introduction. • Gases used during anesthesia & their sources: oxygen, Air, Nitrous oxide, Carbon dioxide, Helium. • Gas Blending & vaporization system. • Breathing Circuits. • Gas Scavenging circuits. • Monitoring the function of the Anesthesia Delivery system.	Biomedical Instrumentation Technology Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	6

	• Monitoring the patient: Control of patient temperature, Monitoring the depth of anesthesia, Anesthesia Computer-aided record keeping, Alarms, Ergonomics, Simulation in anesthesia, Reliability.		
9.	**Haemodialysis Machines:** • Function of the Kidneys (Review). • Artificial kidney (Review). • Dialyzers: Parallel flow dialyzers, Coil Hemodialyzer, Hollow fiber Haemodialyzer, Performance Analysis, Of Dialyzers, Membranes for Hemodialysis. • Hemodialysis Machine. • Portable Kidney Machines	Biomedical Instrumentation Technology Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	6
10.	**Lithotripters:** • The stone disease problem. • First Lithotripter machine. • Modern Lithotripter systems: Focus acoustic shock wave source, Imaging, patient table, Monitoring & Trigger generation. • Extra corporeal shock-wave therapy.	Biomedical Instrumentation Technology Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	3

11.	**Automatic Drug Delivery Systems:** • Infusion Pumps. • Components of drugs infusion systems: Delivering the drug, Syringe pumps, Peristaltic Pumps. • Implantable Infusion systems. • Closed-Loop Control in infusion system. • Examples of Typical Infusion Pumps: Drop Rate Counter Type Infusion Pump, Programmable Volumetric Infusion Pump, Program Controlled Insulin-Dosing Device.	Biomedical Instrumentation Technology Applications. R.S. Khandpur, McGraw Hill, New York, 2005.	4
12.	**Operating Rooms:** • Surgery. • Types of surgery. • OR Personal. • Sterilization. • OR equipment	Introduction to Biomedical Equipment Technology. Joseph J.Carr, John M. Brown, Prentice Hall, New Jersey, 2001.	1

Evaluation Strategies:

		Percentage	Date
1. Exams	First Exam.	20%	--/--/----
	Second Exam	20%	--/--/----
	Final Exam	50%	--/--/----
2. Homework and Projects		10%	
3.Discussions and lecture Presentations			

□ **Teaching Methodology:**

1. Lectures

□ **Textbook**:

1. Biomedical Instrumentation Technology Applications. R.S. Khandpur, McGraw Hill, New York, 2005.

□ **References** :

1. Medical Devices & Systems. Joseph D.Bronzino. Taylor & Francis, 3rd Edition,USA, 2006.

2. Introduction to Biomedical Equipment Technology. Joseph J.Carr, John M. Brown, Prentice Hall, New Jersey, 2001.

3.Biomedical Engineering Fundamentals, Joseph D. Bronzino- Tailor & Francis - 3rd edition – USA, 2006.

Engineering Program

Specialization	**Medical Equipment Maintenance**
Course Number	**20409242**
Course Title	**Medical Treatment Equipment Workshop**
Credit Hours	**2**
Theoretical Hours	**0**
Practical Hours	**6**

□ **Brief Course Description:**

Work shop in support of the Treatment Medical Equipment course. Students must Install Reinstall, and Solve problems for some Treatment medical equipment. Using Operating and service manuals. And how to be careful of the infectious.

□ **Course Objectives:**

Upon the completion of the course, the student will be able to:

1- Know that the treatment is the next step after diagnostic.
2- Solve problems of therapeutic and prosthetic devices.
3- Be care of infection from hemodialysis, ventilators, and anesthesia machines during service.
4- Be careful from hi electric power induced by electrosurgical or defibrillator equipments.
5- Making service and solve problems for treatment medical equipments.
6- Classified the equipments by using Serial Number, Model, and Manufacture.

□

□ **Detailed Course Description:**

Unit. No.	Content	Notes	Time Needed)
1.	Defibrillators.		(1 WEEK)
2.	Electrosurgical machine.		(1 WEEK)
3	Dental Unit.		(2 WEEK)
4.	Laser Type Equipments: ND-YAG Laser, Helium-Neon Laser, Argon Laser, Co2 Laser.		(2 WEEK)
5.	Short Wave Diathermy.		(2 WEEK)
6.	TENS Stimulator.		(1 WEEK)
7.	Electrotherapy.		(1 WEEK)
8.	Ventilator Machine.		(2 WEEK)
9.	Anesthesia Machine.		(1 WEEK)
10	Baby Incubator.		(1 WEEK)
11.	Hemodialysis machine.		(1 WEEK)

Evaluation Strategies:

		Percentage	Date
1. Exams	Assignments	30%	--/--/----
	Midterm Exam	20%	--/--/----
	Final Exam	50%	--/--/----
2. Homework and Projects			
3.Discussions and lecture Presentations			

□ **Teaching Methodology:**

1. Workshop

□ **Textbook**:

□ **References** :
Service, Maintenance and operating manuals of manufacturing companies.

Engineering Program

Specialization	**Medical Equipment Maintenance**
Course Number	**20409243**
Course Title	**Medical Laboratories Equipment**
Credit Hours	**2**
Theoretical Hours	**2**
Practical Hours	**0**

□ **Brief Course Description:**

This course study laboratory medical equipment, principles, functions, factors, diagrams, and other related: Hematology, Blood gas analyzer, Spectrophotometer, Autoclave, Analyzers, coagulometer…etc. The importance of computers in medical sectors.

□ **Course Objectives:**

Upon the completion of the course, the student will be able to:

1. Understand the importance of lab equipments in medical sector.
2. Study types of sensors used in medical laboratory instruments.
3. Explain the work of Hematology work,
4. Explain the work of blood gas analyzer.
5. Study the Coagulometer instrument.
6. Explain the Spectrophotometer theory.
7. Study the importance of computers in medical sectors.

□ **Detailed Course Description:**

Unit. No.	Content	Notes	Time Needed
1.	**Biochemical Sensors:** • Conductivity / Capacitance Electrochemical sensors. • Potentiometer sensors. • Voltametric sensors. • Reference Electrodes.		4
2.	**Optical Sensors:** • Instrumentation: Light source, optical elements, photodetectors, signal processing. • Optical fibers: Probe configurations, Optical fiber sensors, Indicator-mediated Transducers. • General principles of Optical sensing: Evanescent of spectroscopy, Surface plasmon resonance. • Applications: Oximetry, Blood gas analyzer, Immunosensors.		4
3.	**Biological Sensors:** • Diagnostic sensors for measuring proteins & enzymes: Immunoassays, Mass Spectrometry, Electrophoresis, Chromatography. • Sensors for measuring Nucleic Acids: DNA Extraction & amplification, DNA/RNA Probes, SNP Detection. • Sensors for Cellular Processes. • Personalized medicine.		5
4.	**Clinical Laboratory (Separation & Spectral methods):** • Separation Methods. • Chromatographic Separations.		5

	• Gas Chromatography. • High Performance Liquid. • Chromatography. • Fluorometry. • Flame Photometry. • Atomic Absorption Spectroscopy. • and Nephelometry.		
5.	**Clinical Laboratory (Non-spectral Methods & Automation):** • Particle Counting & Identification. • Electrochemical Methods. • Ion-Specific Electrodes. • Radioactive Methods. • Coagulation Timers. • Osmometers. • Automation.		5
6.	**Clinical Laboratory Instruments:** • Spectrophotometery: Interaction radiation with scatter. • Spectrophotometer type instruments: Radiation Sources, Optical Filters, Monochromators, Optical Components, Photosensitive detectors, Sample holders. • Colorimeters: Multi-channel colorimeter (photometer). • Spectrophotometers. • Automatic Biochemical Analysis Systems: The system concepts, the system components. • Clinical Flame Photometers. • Selective-Ion Electrodes Based Electrolytes Analyzer: Ion Analyzers, Chemically sensitive semiconductor devices.		6

7.	Blood Gas Analyzers: • Acid-Base Balance. • Blood PH-Measurement. • Measurement of Blood PCO2. • Blood pO2 Measurement. • Intra-Arterial Blood Gas Monitoring. • A complete Blood Gas Analyzer.		4
8.	Blood Cell Counter: • Types of Blood Cells (Review). • Methods of Cell Counting: Microscopic method, automatic optical method, electrical conductivity method. • Coulter Counters: Multi-parameter coulter counter, picoscale, Errors. • Automatic Recognition & Deferential Counting of Cells.		6
9.	Computers In Biomedical Equipments: • Computer Hardware & Software & Firmware. • Computer Programming Language. • Microprocessor & Microcomputer systems. • Modern Communications. • Digital Signal Processing (DSP). • Computers can Cause Health Problems. • Computer Viruses. • Internet & Medical Computer information. • Computer Based-patient record. • Computer Workstations. • Computer in Laboratory Instrumentation. • Brief glossary of computer and laboratory instrumentation words. • Computer in biomedical equipments.		6

Evaluation Strategies:

		Percentage	Date
1. Exams	First Exam.	20%	--/--/----
	Second Exam	20%	--/--/----
	Final Exam	50%	--/--/----
2. Homework and Projects		10%	
3.Discussions and lecture Presentations			

□ **Teaching Methodology:**

1. Lectures

□ **Textbook**:

1. Biomedical Instrumentation Technology & Applications. R.S. Khandpur, McGraw Hill, New York, 2005.

□ **References** :

1. The Biomedical Engineering Hand Book, Joseph D. Bronzino 2nd edition - Volume (1) – Springer- IEEE Press - CRC Press 2000.

2. Medical Devices & Systems. Joseph D.Bronzino. Taylor & Francis, 3rd Edition, USA, 2006.

3. Introduction to Biomedical Equipment Technology. Joseph J. Carr, John M. Brown, Prentice Hall, New Jersey, 2001.

Engineering Program

Specialization	**Medical Equipment Maintenance**
Course Number	**20409244**
Course Title	**Medical Laboratories Equipment Workshop**
Credit Hours	**2**
Theoretical Hours	**0**
Practical Hours	**6**

□ **Brief Course Description:**

The work shop supports the course of medical lab equipment. Students must Install / Reinstall and Solve problems for Laboratory Instruments in medical sector by Using Catalogue, operating manual, and service manual.

□ **Course Objectives:**

Upon the completion of the course, the student will be able to:

1- Making service for hematology instrument.
2- Solve problems for autoclave.
3- Making Calibration for spectrophotometer and hematology instruments.
4- Classified the equipments by using Serial Number, Model, and Manufacture.
5- Calibrate and Solve major problems for the lab medical equipments.

□ **Detailed Course Description:**

Unit. No.	Content	Notes	Time Needed
1.	Autoclave.		(1 WEEK)
2.	Incubator.		(1 WEEK)
3	Centrifuges & Shakers.		(2 WEEK)
4	Coagulometer.		(1 WEEK)
5	Spectrophotometer.		(2WEEK)
6	Blood Gas Analyzers.		(2 WEEK)
7	flame photometer		(2 WEEK)
8	Hematology.		(2 WEEK)
9	Chemistry Analyzer.		(2 WEEK)

Evaluation Strategies:

		Percentage	Date
1. Exams	Assignments	30%	--/--/----
	Midterm Exam	20%	--/--/----
	Final Exam	50%	--/--/----
2. Homework and Projects			
3.Discussions and lecture Presentations			

□ **Teaching Methodology:**

1. Workshop

□ **Textbook**:

□ **References** :
Service, Maintenance and operating manuals of manufacturing companies.

Engineering Program

Specialization	**Medical Equipment Maintenance**
Course Number	**20409245**
Course Title	**Medical Imaging Equipment**
Credit Hours	**2**
Theoretical Hours	**2**
Practical Hours	**0**

□ **Brief Course Description:**

Study X-Ray Equipment, ultrasonic scanning, and MRI: Principles, Functions, factors, diagrams, and Learn more about safety limits.

□ **Course Objectives:**

Upon the completion of the course, the student will be able to:

1- Understand the importance of Image equipment in the medical sector.
2- Study the X-ray Theory.
3- Study the MRI Theory.
4- Explain the MRI device.
5- Study the ultrasound theory.
6- Explain the Ultrasound Scanner.
7- Explain the function of CT Scanning machine.
8- Explain the Function of Gamma ray machine.
9- Explain principles of Thermal Imaging System.
10- Study the safety limits to save our selves from the effects of x-ray and gamma ray.

□ **Detailed Course Description:**

Unit. No.	Content	Notes	Time Needed/hour
1.	**Physics of Radiography:** • Atomic Structure. • Electron Bending Energy. • Ionization & Excitation. • Electromagnetic Radiation. • Primary Energetic Electron Interactions. • Primary Electromagnetic Radiation Interactions. • Production of X-Rays. • Bloch Diagram and operation. • The Interaction of X-ray and Gamma- ray With Matter. • Compton Process (Modified Scatter). • Photoelectric Absorption. • Properties of X-ray & Gamma ray. • Absorbed Dose. • Filtration.		6
2.	**Projection Radiography:** • Attenuation of X-rays by the patient: Limiting patient dose, Effect of tube kilo voltages on patient dose, effect of focus-film distance on patient dose, Subject contrast, contrast media, • Effect of scattered radiation: scatter reduction and contrast improvement. • Secondary Radiation Grids: Effect on scattered rays, Grid ration, Contrast improvement factor, Crossed Grids, Effect on direct rays, Focused & unfocused grids, grid cut-off, Stationary & moving grids, speed & selectivity, moving slot.		6

	• Magnification & Distortion: Geometrical unsharpness, movement unsharpness, absorption unsharpness. • Tomography. • Limitations of the x-ray tubes: Line focus, rotating anode tube, Heat rating, Uniformity of the x-ray beam, Quality assurance of exposure parameters.		
3.	**Radiography with films & Screens:** • Intensifying screens: Matching film & phosphor. • Films: exposure to light, Processing. Density. • Characteristic Curve: Exposure latitude, Effect of developing conditions, Quality assurance. • Use of screens: Film exposed directly to x-rays, Film exposed with screens. Intensification factor, front & back screens, Reciprocity law, After glow. • Radiographic Contrast: Screen Blurring, • Quantum Mottle or noise. • Choice of exposure factors. • Macroradiography. • Mamography: Contrast, Image definition, Dose. • Xeroradiography.		5
4.	**Fluoroscopy, Digital Imaging, and Computed Tomography:** 1. Fluoroscopy: • Image Intensifier: Gain, Dual & Triple mode, Beam splitter, Vignetting. • Block Diagram & Operation. • The television system: Camera Tube,		6

	Monitor Tube, Video Tape Recording. • Cameras: Cineradiography, Photospot film camera. • Image Quality: Resolution, Contrast, Dynamic range of the television monitor, Noise, Typical Doses & dose rates, Quantum sink. 2. Digital Imaging: • Equipment: Digitizer, Computer, Image display, Digital photospot. • Image processing, storage, and recording: Windowing, Background subtraction, Noise reduction, Edge enhancement, Data shifting, Image Storage, Cameras. • Imaging Subtraction Angiography: Noise, Temporal subtraction, energy subtraction, hybrid subtraction. • Quality Assurance. • Clinical Applications of x-ray imaging: Mammography, Abdominal x-ray scans, 3. Computed Tomography (CT): • Principles of computed tomography imaging: CT Numbers, scanning the patient, acquiring the data, reconstructing the image, Windowing. • CT Instrumentation: CT Generations, X-ray source and collimation, CT Detectors, Gantry, slip ring, and patient table. • CT scanner: Configurations, Detectors. • Image Quality: Noise, Spatial resolution of high/ Low contrast objects, Contrast resolution, trade off, Dose, Artifacts. • Other Techniques: Zoom reconstruction, Scanning in other planes, Spiral (Helical) Scanning, Two & three dimensional reformatting, Cine CT Scanning. • Picture Archiving & communication system		

	(PACS). • Clinical Applications of computed tomography: Cerebral Scans, Pulmonary disease, Abdominal imaging.		
5.	**Gamma Imaging:** • Radioactivity: Stable nuclei, Isotopes, Radio nuclides. • Radioactive Transformation (Decay): Nuclides with a neutron deficit, K-electron capture, Gamma rays, Bata rays, positron emitters, Radioactive decay. • Gamma Imaging: The multihole collimator, The crystal, photomultipliers, pulse arithmetic, pulse height spectrum, pulse height analyzer, the monitor, he computer, dynamic imaging, types of gamma camera, collimators. • Characteristics and quality assurance of the gamma image: Uniformity of field, spatial resolution, linearity, energy resolution, temporal resolution, sensitivity, noise. • Block Diagram & Operation. • Radiopharmaceutical: Desirable properties, technetium generator, preparation. • Dose to the patient: dose to an organ, effective dose to the body, typical activities and dose. • Precautions to be taken in the handling of the radionuclides: Segregation, personal protection, patient protection. • SPECT Imaging.		6
6.	**Radiation Hazards & Protection:** • Ionizing radiation interactions with tissue. • Radiation quantities and units. • Somatic & Genetic Effects of ionizing radiation. • Ionizing radiation contributions to population		3

	exposure. • Radiation protection principles: justification Optimization, limitation. • Statutory responsibilities & Organizational arrangements for radiation protection. • Patient dosimetry. • Practical reduction of dose to staff & visitors. • Personal dosimetry systems: Film badges, thermoluminescent dosimeters, electronic dosimeters.		
7.	**Planar Scintigraphy:** • Instrumentation: Collimators, Scintillation Crystal, Photomultiplier tubes, Positioning Logic, Pulse Height Analyzer, Gating Circuit Image Capture. • Imager Formation, Event position estimation, Acquisition Modes. • Image quality: Resolution, Sensitivity, Uniformity, Energy Resolution, Noise. • Factors affecting Count rate.		3
8.	**Ultrasonic Imaging:** • General Principles. • Wave Propagation & Characteristic acoustic impedance. • Wave reflection & refraction. • Energy loss mechanisms in tissue: Absorption, Scattering, Attenuation. • Instrumentation: Single Crystal Transducers, Transducer Arrays, ultrasound probes, mechanical scanner, electronic scanner, Beam forming & time-gain compensation. • Diagnostic Scanning Modes: A-Mode, M-Mode, and B-Mode Scans, Three dimensional Imaging. • Artifacts in Ultrasonic Imaging. • Image Characteristics: Signal-to-noise ratio, spatial resolution, Contrast-to-noise		4

	ratio. • Compound Imaging. • Blood velocity measurements using ultrasound: The Doppler Effect, Continuous wave Doppler measurement, Pulsed-mode Doppler measurements, color Doppler/B-Mode duplex imaging, Time-domain correlation/ Color Velocity Imaging. • Ultrasound Contrast agents, Harmonic imaging, and pulse inversion techniques. • Safety & Bioeffecs in ultrasonic imaging. • Clinical Applications of ultrasound: Obstetrics & Gynecology, Breast imaging, musculoskeletal structure, Cardiac disease.		
9.	**Magnetic Resonance Imaging:** • The spinning Proton. • The magnetic resonance signal. • Atomic Magnetism. • Instrumentation: Magnet design, Magnetic field gradient coils, & Coils, radiofrequency coils, super conducting magnets. • Imaging Sequences: Spin ECHO-sequence, T1 & T2 weighted imaging sequences, Multislice imaging, rapid gradient echo sequences & three-dimensional imaging, echo planner imaging, spiral imaging. • Spatial encoding. • Characteristics of the magnetic resonance image. • Magnetic resonance angiography: Time of flight methods, phase contrast methods. • Diffusion-weighted imaging. • IN VIVO localized spectroscopy. • Functional MRI. • Clinical Applications of MRI: Brain, Liver & the Reticuloendothelial system, Musculoskeleal System, Cardiac System • Artifacts.		5

	• Quality assurance. • Hazards.		
10.	**Thermal Imaging Systems:** • Medical Thermograph. • Physics of thermograph. • Infrared detectors. • Thermographic Equipment. • Quantitative Medical Thermography. • Pyroelectric Vidicon Camera. • Thermal camera based on IR Sensor with digital focal plane array.		5

Evaluation Strategies:

		Percentage	Date
1. Exams	First Exam.	20%	--/--/----
	Second Exam	20%	--/--/----
	Final Exam	50%	--/--/----
2. Homework and Projects		10%	
3.Discussions and lecture Presentations			

□ **Teaching Methodology:**

1. Lectures

□ **Textbook**:

1. Biomedical Instrumentation Technology & Applications. R.S. Khandpur, McGraw Hill, New York, 2005.

References:

1. Medical Imaging Signals and Systems. Jerry L. Prince, Jonathan, M. Links. Pearson prentice Hall, Johns Hopkins University, New Jersey, 2006.

2. Physics for Medical Imaging. RF Farr and PJ Allisy-Roberts, Saunders, Great Britain. 2004.

3. Radiation Exposure and Image Quality in X-ray Diagnostic Radiology/ **Physical Principles and Clinical Applications**. Horst Aichinger, Joachim Dierker, Sigrid Joite-Barfuß, Manfrid Säbel. Springer - Verlag Berlin Heidelberg / New York. 2004.

4. Introduction to Biomedical Equipment Technology. Joseph J. Carr, John M. Brown. Prentice Hall / 4th edition. New Jersy 2001.

5. Medical Devices & Systems. Joseph D. Bronzino. Taylor & Francis. USA, 3rd edition, 2006.

6. Introduction to Biomedical Imaging. Andrew Webb. University of Illinois Urbana, IL, Wiley-interscience, New Jersey, 2003.

Engineering Program

Specialization	**Medical Equipment Maintenance**
Course Number	**20409246**
Course Title	**Medical Imaging Equipment Workshop**
Credit Hours	**2**
Theoretical Hours	**0**
Practical Hours	**6**

□ **Brief Course Description:**

Describe the parts of the equipment has been studied in **Imaging Medical Equipment** course practically, and doing service for some of them. Show how they work. Learn how to safe human from x-ray waves.

□ **Course Objectives:**

Upon the completion of the course, the student will be able to:

1. Check the electrode sensor of Ultrasound equipment.
2. Use the ultrasound as a user.
3. Check and solve problems of the ultrasound equipment.
4. Use the x-ray machine, and be care of x-ray dangers.
5. Be familiar with Computer Tomography Machine.
6. Be familiar with Gamma ray machine.
7. Use the protectors needed when using the x-ray machine.
8. Solve some problems for the x-ray machine.

□ **Detailed Course Description:**

Unit. No.	Content	Notes	Time Needed
1.	Using X-ray exposure & all the parameters of a machine. Using protection conditions & radiometer tester.		2 weeks
2.	Mobile X-ray. Check the Tube & power supply and exposure control system.		2 weeks
3.	Table of Fluoroscopy x-ray machine & power boards checks.		2 weeks
4.	Computer Tomography. (Using)		2 weeks
5.	Computer Tomography (General Checks)		2 weeks
6.	Gamma ray machine (Using)		2 weeks
7.	Gamma ray (General checks).		2 weeks
8.	Ultrasound Scanner.		2 weeks

Evaluation Strategies:

		Percentage	Date
1. Exams	Assignments	30%	--/--/----
	Midterm Exam	20%	--/--/----
	Final Exam	50%	--/--/----
2. Homework and Projects			
3.Discussions and lecture Presentations			

□ **Teaching Methodology:**

1. Workshop

□ **Textbook**:

□ **References** :
Service, Maintenance and operating manuals of manufacturing companies.