Middle Technical University
الجامعة التقنية الوسطى

First Cycle – Bachelor's Degree (B.Sc.) - **Medical Instrumentation Engineering Techniques**

بكالوريوس – هندسة تقنيات الأجهزة الطبية (الدورة الأولى)

Table of Contents

1. Overview

This catalogue is about the courses (modules) given by the program of Medical Instrumentation Engineering Techniques to gain the Bachelor degree. The program delivers (48) Modules with (7200) total student workload hours and 240 total ECTS. The module delivery is based on the Bologna Process.

نظره عامة

يتناول هذا الدليل المواد الدراسية التي يقدمها برنامج هندسة تقنيات الأجهزة الطبية للحصول على درجة البكالوريوس. يقدم البرنامج (48) مادة دراسية، مع (7200) إجمالي ساعات حمل الطالب و ٢٤٠ إجمالي وحدات أوروبية. يعتمد تقديم المواد الدراسية على عملية بولونيا.

2. Undergraduate Courses 2023-2024

Module 1

Code	Course/Module Title	ECTS	Semester
MIET1101	Fundamental of Electrical Engineering	7	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	4	102	108
Description			

This module covers the fundamental concepts and principles of electrical networks and their applications. Students comprehensively understand electrical engineering, including their symbols, units, ohms low, network methods, network theorems, delta -star and circuit analysis. They learn to analyze, solve, draw connect and simplify different complicated circuits. Topics include DC and AC basic subjects like: The direct–current network (Kirchhoff's law & their use in network), Conversion of delta–connected resistance into an equivalent Wye connection & Vic versa, Power sources are connected in parallel, Circuit analysis methods Circuit analysis Theorems, Generation of alternating current, Sinusoidal current The mean values of current and voltage. The effective values of current and voltage. The vector diagram. The instantaneous power and mean power of A.C, relative and apparent power transient circuit and RC transient circuit.3-Phase system, and magnetic circuits.

Module 2

Code	Course/Module Title	ECTS	Semester
MIET1102	Computer Applications (IC3)	5	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	76
Description			
This module provides a foundation in computer hardware, software, operating systems, and peripherals. It covers understanding operating systems, computer hardware, power options, and utilizing the control panel. Learners will explore software types, Microsoft Office (Word, Excel, PowerPoint and outlook), and popular applications like G-Suite (Docs, Sheets, Slides, Gmail, Calendar).			

Module 3

Code	Course/Module Title	ECTS	Semester
MIET1103	Differential Mathematics	5	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	2	73	77
Description			
Differential mathematics is a branch of calculus that focuses on the concept of differentiation. It involves finding rates of change, slopes of curves, and optimizing functions. Differential equations are used to model various phenomena and solve problems in fields such as physics, and engineering.			

Module 4

Code	Course/Module Title	ECTS	Semester
MIET1104	Engineering Drawing	5	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
	4	59	91
Description			
This course teaches engineering drawing fundamentals and AutoCAD usage, covering menus, toolbars, commands, and dimensioning techniques. Students learn to create accurate drawings following engineering drawing conventions and apply them in AutoCAD. They also explore the valuable utilities offered by AutoCAD for engineering drawing and study orthogonal projection in both traditional geometry and AutoCAD.			

Module 5

Code	Course/Module Title	ECTS	Semester
MIET1105	Human rights and Democracy	2	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2		30	30
Description			

This course provides a comprehensive understanding of democracy as a way of life, its relationship with freedom, different public freedoms, and the traits, advantages, elements, and forms of democracy. It also covers election procedures and potential manipulation, Iraq's election laws, the development of democracy, constitutional and legal rights, human rights, and fostering a culture of dialogue and acceptance.

Module 6

Code	Course/Module Title	ECTS	Semester
MIET1106	English Language (Beginner Level)	3	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	1	45	45
Description			

The beginner English language course introduces essential language skills for beginners. It covers basic grammar, vocabulary, listening, speaking, reading, and writing exercises. The course focuses on developing foundational English proficiency and building confidence in using English in everyday situations.

Module 7

Code	Course/Module Title	ECTS	Semester
MIET1107	Arabic Language	3	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	1	45	45
Description			

The course introduces the basic rules of the Arabic language, which can be used in the academic environment.   The module involves teaching the concept of the Arabic language as a tool and means of communication between individuals. Introducing the student to the method of forming sentences using the tools of the Arabic language. Enabling the student to write using correct and basic linguistic and grammatical rules and their scientific applications.

Module 8

Code	Course/Module Title	ECTS	Semester
MIET1201	Medical Physics	6	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	106
Description			

This module provides physics background for medical instrumentation engineers, covering forces in the body, physics of the skeleton, energy, work, and power. It explores the physics behind organ functions like respiratory, urinary, and cardiovascular systems, and introduces related instruments. It also includes the physics of hearing and highlights radiation therapy.

Module 9

Code	Course/Module Title	ECTS	Semester
MIET1202	Medical Chemistry	6	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	106	180
Description			

This course represents an introduction to the principles of chemistry, the definition of matter, systems of units of measurement, how to write chemical formulas and reaction equations and balance them for later use in mathematical calculations, in addition to the various ways to express the concentration of a substance and the decomposition constants of acids, bases, and poorly soluble salts as the theoretical basis for the qualitative and quantitative analysis of the practical approach. Moreover, focus on statistical treatments of the results of analyzes or to assess the efficiency of an analytical device or method.

In addition to studying the interrelationship between chemistry and physics and the consequent laws, it also aims to study the states of matter and methods of conversion from one state to another with the properties of each of them and what is looking at the conversion of energy into work or vice versa, as well as the study of heat resulting from chemical reactions The various working principles and components of devices used for analytical purposes in chemistry, with a focus on spectrophotometers.

Module 10

Code	Course/Module Title	ECTS	Semester
MIET1203	Mechanics	5	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	1	45	105
Description			

This module covered the fundamental concepts and principles of mechanics, and their applications in statics loads. Students comprehensively understand mechanics, including their forces, result of force, stress and strain, moment of force, friction, bending force, selective of materials, welding joint, and load distribution in trusses and bridge. They learn mechanical design, development, and various mechanical tests. Topics include mechanics /statics basics, mechanical properties, and mechanical test of materials.

Module 11

Code	Course/Module Title	ECTS	Semester
MIET1204	Integral Mathematics	5	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	2	73	77
Description			

Integral mathematics is a branch of calculus that deals with the concept of integration. It involves finding the area under curves, calculating accumulated quantities, and solving differential equations. Integrals are used to analyze continuous functions and provide a framework for solving a wide range of mathematical and real-world problems.

Module 12

Code	Course/Module Title	ECTS	Semester
MIET1205	Engineering Workshops	5	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
-	4	60	90
Description			

The Mechanical, Electrical and Electronic Workshop module aims to provide students with hands-on experience and theoretical knowledge in mechanical and electrical engineering. Overall, this module aims to provide students with practical skills and a theoretical understanding of Mechanical, Electrical and Electronic engineering, enabling them to work with machinery, manipulate metals, and work with electronic components and circuits.

Module 13

Code	Course/Module Title	ECTS	Semester
MIET1206	Computer Programming and Applications (MATLAB-beginner)	3	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	2	46	44

Description

This module covers the fundamental concepts of MATLAB programming language environment. The students will understand and learn how to use MATLAB as an effective programming language to solve different mathematical and engineering problems as well as using plotting functions and design projects using codes or GUI. Students will acquire the knowledge of basic MATLAB syntax such as: variables, input, output, vectors, matrices, functions, plotting, and GUI, and these topics will be illustrated using some examples. The students will gain the necessary skills to design and implement appropriate algorithms that solve problems dealing with different mathematical and engineering applications.

Module 14

Code	Course/Module Title	ECTS	Semester
MIET2101	Laboratory Medical Instrumentation I	6	3
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	106
Description			

This module covers the fundamental concepts and principles of medical instrumentation. The topics explained in this module Definition of medical instruments. Introduction to medical instruments and Classification of medical instrumentation. Explain the Design of hospitals and the design of operating rooms. One of the most important topics is Patient Safety. Medical Laboratory Instruments and Tools. Calibration of Medical Laboratory Instruments. Introduction to Balance. Balance and their types. Wax bath and Water bath.

Module 15

Code	Course/Module Title	ECTS	Semester
MIET2102	Electronics Circuits I	6	3
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	106
Description			

This module covers various topics related to electrical circuits and semiconductor devices. Students learn about sinusoidal excitation, semiconductor materials, diode applications, bipolar junction transistors (BJTs), DC biasing of BJTs, field-effect transistors (FETs) and MOSFETs, FET biasing, BJT AC analysis, and small-signal AC analysis of BJT amplifiers. The module equips students with the knowledge and skills to design and analyze electronic circuits and devices.

Module 16

Code	Course/Module Title	ECTS	Semester
MIET2103	Electrical Machines	6	3
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	76
Description			

This course covers the basic concepts and principles of electricity technology and its applications. Where students understand and help them know the types of transformers, their applications, and designs, as well as the designs of electrical machines such as generators and motors, with direct current and alternating current and their components. It also deals with the methods of finding the appropriate design for the places used and their applications in medical devices and the results of mathematical quantities in designs through solving mathematical and mathematical problems for various applications. The students were also able to develop their capabilities in dealing with electrical parts in medical devices and methods of checking, maintaining, and repairing them.

Module 17

Code	Course/Module Title	ECTS	Semester
MIET2104	Engineering Mathematics	5	3
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	2	73	77
Description			

Engineering mathematics is the application of mathematical principles and techniques to solve engineering problems. It encompasses various mathematical topics, including calculus, differential equations, linear algebra, probability theory, and numerical methods. Engineering mathematics provides a foundation for analyzing and designing engineering systems, from structures to electrical circuits.

Module 18

Code	Course/Module Title	ECTS	Semester
MIET2105	Anatomy & Physiology	5	3
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	76
Description			

In this course, the student is prepared to study and understand medical devices by explaining the physiological changes, especially the electrical ones, that occur when the body's various organs perform their function and their relationship to the devices used to measure and diagnose various phenomena and diseases. Moreover, the module prepares the student to study and understand medical devices by clarifying the physiological changes, especially the electrical ones, that occur when the body's various organs perform their function and their relationship to the devices used to measure and diagnose various phenomena and diseases.

Module 19

Code	Course/Module Title	ECTS	Semester
MIET2106	The crimes of the Ba'ath Regime in Iraq	2	3
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	-	30	30
Description			

This course aims to enhance students' understanding of crimes and violations at the Ba'ath regime in Iraq and their impact on individuals and society. It also encourages analysis and debate on these critical issues. One of the primary course objectives is for students to grasp the concept of crimes and their categories, study Ba'ath regime crimes and related laws, identify psychological and social offenses and their societal effects, analyze legal violations in Iraq (including human rights abuses), explore environmental crimes and their effects (e.g., pollution, urban and rural destruction, marshland drainage), and delve into mass grave crimes, cemetery events, and their chronological classification in Iraq.

Module 20

Code	Course/Module Title	ECTS	Semester
MIET2201	Electronics Circuits II	6	4
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	106
Description			

The Electronics Circuits II course delves into advanced concepts in electronic circuits. Topics covered include amplifiers, oscillators, feedback systems, filters, and analog integrated circuits. Students learn to analyze, design, and optimize complex electronic circuits for applications in communication systems, audio amplification, and signal processing, furthering their understanding of electronic circuit theory and practical implementation.

Module 20

Code	Course/Module Title	ECTS	Semester
MIET2202	Laboratory Medical Instrumentation II	6	4
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	106
Description			

This module covers the fundamental concepts and principles of medical instrumentations and their classification. The main topics introduction to the laboratory Design and part from laboratory devices like centrifuges, the definition of microscopes, and Types of Microscopes. Polymerase chain reaction (pcr). definition of Laboratory incubators. types of Laboratory Incubators, ovens, and their medical application. Autoclave and its medical application. Water distillation. definition of the Rehabilitation System. Classification of Medical Rehabilitation System.

Module 21

Code	Course/Module Title	ECTS	Semester
MIET2203	Digital Electronics	5	4
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	76
Description			

This module covers the basic concepts and fundamental principles of digital electronic circuits. The students understand comprehensively the applications of digital electronic circuits; include the work principles of medical instruments, which include these digital circuits. Furthermore, they can learn how to design, to develop, and to maintain these instruments.
The subject of digital electronic circuits covers numbers of systems, digital codes, arithmetical processes, flip-flop circuits and arithmetical circuits. In addition, students learn designing of electronic counters and their work principles, shift-registers, and conversion process from digital to analog.

Module 22

Code	Course/Module Title	ECTS	Semester
MIET2204	Clinical Chemistry Instrumentation	5	4
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	60	90
Description			

This module covers the introduction of clinical chemistry and study the chemical and biochemical mechanism of the human body in relation to disease. Students comprehensively understand clinical chemistry instrumentation: spectrophotometer types, Auto-analyzer types, Electrophoresis, Elisa, Body mass index. They learn to explain their principal work, operation, maintenance, and faults. Topics include protein, fats, minerals, enzymes, and their importance in the human body. They understand the immunology concept and their effects on the human body.

Module 23

Code	Course/Module Title	ECTS	Semester
MIET2205	Biomedical Transducers and Sensors	5	4
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	60	90
Description			

The Biomedical Transducers and Sensors course explores the principles and applications of transducers and sensors in the biomedical field. Topics covered include sensor technologies, signal conditioning, measurement techniques, and the interface between sensors and biological systems. Students learn to select, design, and analyze biomedical sensors for accurate and reliable data acquisition in healthcare and research settings.

Module 24

Code	Course/Module Title	ECTS	Semester
MIET2206	English Language (Intermediate Level)	3	4
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	1	45	45
Description			

The intermediate English language course, based on the New Headway Plus - develops language skills at an intermediate level. It covers grammar, vocabulary, listening, speaking, reading, and writing exercises. The course emphasizes building a solid foundation in English communication, comprehension, and expression, fostering confidence in everyday conversations and interactions.

Module 25

Code	Course/Module Title	ECTS	Semester
MIET3101	Medical Diagnostic Instrumentation I	7	5
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	136
Description			

This module covers the fundamental concepts and principles of many medical diagnostic equipment and instrumentations that are used in hospitals and clinics. The students will understand the different parts of medical diagnostic instrumentation and the idea behind these parts as well as their operation. The student will be able to get the necessary knowledge to diagnose the faults may occur in each part and manage to fix it as well as develop some alternatives in emergencies. The students may gain skills to design and develop such instrumentations in the healthcare field. Medical diagnostic instrumentations are a form of medical equipment used to diagnose health conditions.

Diagnostic medical equipment are important to healthcare because they assist providers in evaluating patient health. Having instruments to process testing samples and tools to measure critical vitals, such as body temperature and heart rate, can lead to better patient diagnoses and treatment. Many diagnostic instrumentations will be discussed thoroughly replicated by the biomedical recorders (ECG, EMG, EEG, EOG, VCG, PCG, Digital Stethoscope), Audiometers and Hearing Aids, Ophthalmic Instruments and Diagnostic Tests and …..etc . Once the diagnosis is performed, the doctor at that point refers to a proper treatment plan for the analyzed issue. Diagnostic medical equipment are important to healthcare because they assist providers in evaluating patient health. Having instruments to process testing samples and tools to measure critical vitals, such as body temperature and heart rate, can lead to better patient diagnoses and treatment. This module describe the physiological basis and engineering principles of electro-medical equipment, also includes information on the principles of operation and the performance parameters of a wide range of instruments. Broadly, this module covers recording and monitoring instruments, measurement and analysis techniques.

Module 26

Code	Course/Module Title	ECTS	Semester
MIET3102	Microprocessor	6	5
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	4	88	92
Description			

This module covers the fundamental concepts and principles of microprocessors and their applications. Students comprehensively understand microprocessors, including their architecture, memory systems, I/O interfacing, instruction sets, timing, and standard buses. They learn to design, develop, and program (assembly language programming) microprocessor-based systems for various applications. Topics include microprocessor basics, semiconductor and auxiliary memories, microprocessor architecture, bus and I/O timing, microprocessor interfacing, instruction set architecture, digital and analog I/O, standard bus architectures, and practical microprocessors.

Module 27

Code	Course/Module Title	ECTS	Semester
MIET3103	Electromagnetic Fields	5	5
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	76
Description			

The electromagnetic fields course explores the principles and behavior of electromagnetic fields. Topics covered include electrostatics, magnetostatics, electromagnetic waves, and Maxwell's equations. Students learn about field interactions, propagation, and the application of electromagnetic theory to practical engineering problems in areas such as telecommunications, antennas, and electromagnetic compatibility.

Module 28

Code	Course/Module Title	ECTS	Semester
MIET3104	Signals and systems	5	5
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	60	90
Description			

The signals and systems course introduces fundamental concepts and mathematical tools for analyzing continuous and discrete-time signals and systems. Topics covered include signal representation, Fourier analysis, convolution, Laplace and Z-transforms, and system characterization. The course focuses on understanding the behavior and properties of signals and systems in both time and frequency domains.

Module 29

Code	Course/Module Title	ECTS	Semester
MIET3105	Computer Programming and Applications (C++ programming)	4	5
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	60	60
Description			

This module introduces beginners to computer programming and applications using the C++ programming language. Students learn the basics of C++ syntax, data types, control structures, functions, and object-oriented programming concepts. They gain hands-on experience through coding exercises and projects to develop practical programming skills and problem-solving abilities.

Module 30

Code	Course/Module Title	ECTS	Semester
MIET3106	English Language (Advanced Level)	3	5
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	1	45	45
Description			

The advanced English language course enhances language proficiency at an advanced level. It covers complex grammar structures, vocabulary expansion, idiomatic expressions, and advanced reading and writing skills. The course focuses on improving fluency, accuracy, and communication abilities in English.

Module 31

Code	Course/Module Title	ECTS	Semester
MIET3201	Medical Diagnostic Instrumentation II	7	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	136
Description			

This module considers technological innovations and introduction of new and improved methods of medical diagnosis systems, capturing recent developments and discussing new topics. This module includes subjects on 'Telemedicine Technology', which shows how information and communication technologies have made significant contribution in better diagnosis and treatment of patients and management of health facilities. This module describes the engineering principles of imaging systems and equipment's such as X-ray Machines and Digital Radiography. Further, it includes information on the principles of operation and the performance parameters of a wide range of imaging systems. Broadly, this module covers a wide range of modern imaging systems such as Modern Ultrasound Imaging Systems, Three – Dimensional Ultrasound Imaging Systems, Portable Ultrasound Systems, Thermal Imaging Systems and Magnetic Resonance Microscopy. Having a discussion on applications of new topics, including Gamma Knife, Cyber Knife, Multislice CT Scanner, Digital Radiography, Single-Photon – Emission Computed Tomography (SPECT), Gamma Camera, Positron Emission Tomography (PET) Scanner.

Module 32

Code	Course/Module Title	ECTS	Semester
MIET3202	Medical Electronic Systems	6	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	106

Description
This module provides an in-depth exploration of medical electronic systems, focusing on the principles, technologies, and applications that underpin the field of medical electronics. Students will gain a comprehensive understanding of the design, operation, and integration of electronic systems used in various medical disciplines, including healthcare monitoring, diagnostics, therapeutic devices, and imaging systems. The module aims to equip students with the knowledge and skills necessary to analyze, design, and evaluate medical electronic systems. Students will learn about the regulated power supplies, clippers circuits, operational amplifiers applications, filters and data analysis methods employed in medical electronics. They will also explore the regulatory frameworks and standards governing the development and deployment of medical electronic systems.

Module 33

Code	Course/Module Title	ECTS	Semester
MIET3203	Medical Communication systems	6	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	60	120
Description			

Description
The communication course focuses on developing effective verbal and written communication skills. Topics covered include interpersonal communication, public speaking, business writing, and nonverbal communication. Students learn to express ideas clearly, listen actively, and adapt their communication style to various contexts, fostering effective communication in personal and professional interactions.

Module 34

Code	Course/Module Title	ECTS	Semester
MIET3204	Power Electronics	5	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	76
Description			

Description
This module covers the fundamental concepts and principles of power electronics and their applications. Students comprehensively understand the application of power electronics, including their Rectifier, chopper, ac-ac controller, inverter. They learn to design, develop, power supply, UPS, switch mode power supply for various applications. Topics include thyristor, transistor, diode as switch This module covers the fundamental concepts and principles of power electronics and their applications. Students comprehensively understand the application of power electronics, including their Rectifier, chopper, ac-ac controller, inverter. They learn to design, develop, power supply, UPS, switch mode power supply for various applications. Topics include thyristor, transistor, diode as switches and state of different type of power electronics applications.

Module 35

Code	Course/Module Title	ECTS	Semester
MIET3205	Project I	3	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	1	60	90
Description			

The project for medical instrumentation engineering techniques is designed to provide students with hands-on experience in applying their knowledge of medical instrumentation to solve real-world problems. The project focuses on the practical aspects of designing, building, and testing medical devices and systems. The junior project is a valuable learning experience that allows students to integrate theoretical knowledge with practical skills. It helps them develop critical thinking, teamwork, and communication skills, essential for success in medical instrumentation engineering. Students work in teams and are assigned a specific problem or challenge related to medical instrumentation. They must research and understand the problem, identify the appropriate engineering techniques and methodologies to address it and develop a solution. The project typically involves the following stages that are considered the first steps in the project:

Problem Definition: Students begin by clearly defining the problem they aim to solve. This includes understanding the project's requirements, constraints, and objectives and searching for the main components related to the project design based on the new scientific research.
Design and Planning: Students develop a detailed design plan that outlines the steps, resources, and timeline required to complete the project. They may need to consider safety, regulatory compliance, and user requirements.

Module 36

Code	Course/Module Title	ECTS	Semester
MIET3206	Project Management	3	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	-	45	45
Description			

This course covers the basic concepts and principles of how to manage projects, modern methods of planning projects, methods of applying them, setting timetables for them, studying all theories in planning, and finding out the weaknesses and strengths of each theory. Students also understand how to do a feasibility study for projects, calculate costs of all kinds, and calculate annual profits and losses in different ways through the use of international accounting theories followed and studies in managing and creating projects and proposing suitable solutions to keep pace with the needs of the labor market and what society needs of graduates in the field of engineering in the field of medical devices and developing their skills Knowledge, accounting and planning.

Module 37

Code	Course/Module Title	ECTS	Semester
MIET4101	Medical Therapeutic Instrumentation I	7	7
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	136
Description			

This module covers the fundamental concepts and principles of many medical therapeutic instruments that are used in hospitals and clinics. The students will understand the different parts of medical therapeutic instrumentation and the idea behind these parts as well as their operation. The student will be able to get the necessary knowledge to diagnose the faults that may occur in each part and manage to fix them as well as develop some alternatives in emergencies. The students may gain skills to design and develop such instrumentations in the healthcare field. Many instruments will be discussed thoroughly like electrosurgical machines, heart-lung machines, hemodialysis machines, dental chairs, and many other important therapeutic instruments.

Module 38

Code	Course/Module Title	ECTS	Semester
MIET4102	Medical Laser Systems	5	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	76
Description			

This module covers the fundamental concepts of laser generation, optical fiber, medical laser types, laser detector and laser medical application. Students comprehensively understand the medical laser types that are used in appropriate medical laser applications, including therapy treatment and medical surgery. They learn to design, develop, and program medical laser devices. Topics include gases laser like CO_2, semiconductor laser and optical fiber as a delivery laser system.

Module 39

Code	Course/Module Title	ECTS	Semester
MIET4103	Control Systems	5	7
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	76
Description			

Control systems are very important in robotics which are used in biomedical applications. This module covers the use of feedback control for linear time-invariant systems, including the design of PD, PI and

PID controllers, and the implementation of controllers using digital techniques. Also, the stability of medical instrumentation is very important to check it before used in the medical field. The laboratory sessions make use of a medical wheeled robot or any smart medical device with line-following sensors, and give practical experience of modelling, controller design, and controller implementation.

Module 40

Code	Course/Module Title	ECTS	Semester
MIET4104	Project II	5	7
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
-	3	44	106
Description			

Prototyping and Construction: Students use their engineering skills to build prototypes or models of medical instruments or systems. They may need to fabricate components, integrate sensors and actuators, and develop the necessary circuitry or software.

Testing and Evaluation: Students rigorously test their prototypes to ensure they meet the specified requirements and function as intended. They may conduct experiments, collect data, and analyze the performance of their device or system.

Documentation and Presentation: Students document their project work, including design drawings, test results, and any modifications made during the development process. They prepare a final report and present their findings to faculty members or a panel of judges.

Throughout the project, students are encouraged to apply engineering principles, problem-solving skills, and their understanding of medical instrumentation concepts. They may also collaborate with healthcare professionals or industry experts to gain insights into the practical application of their projects.

The project is a valuable learning experience that allows students to integrate theoretical knowledge with practical skills. It helps them develop critical thinking, teamwork, and communication skills, essential for success in medical instrumentation engineering techniques.

Module 41

Code	Course/Module Title	ECTS	Semester
MIET4105	Biomedical Signal Processing	4	7
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	60	60
Description			

The biomedical signal processing course provides an overview of techniques used to analyze and interpret signals from the human body. Characteristics of medical data, physiological signals analyzer, medical care system, nature of biomedical signals, signal acquisition. Also, random physiological signals, signal as stochastic process, averaging techniques, sampling theorem, windowing and many other topics will cover during the module. The course emphasizes the application of these techniques in medical diagnostics, monitoring, and research, fostering skills in biomedical signal analysis and interpretation.

Module 42-Elective I

Code	Course/Module Title	ECTS	Semester
MIET4106	Microcontrollers	4	7
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	60	60
Description			

This module provides an in-depth exploration of the fundamental concepts and principles underlying microcontrollers and their applications. Students will gain a comprehensive understanding of different types of Arduino microcontrollers, including their platforms and the programming languages employed, such as C/C++ and MATLAB. They will learn how to design, develop, and program microcontroller-based systems specifically tailored for various biomedical applications. Key topics covered in this module include instruction set for digital and analog inputs of Arduino, programming analog and digital sensors, utilizing LCDs, handling hardware interrupts, implementing pulse width modulation, generating sine, square, and triangle waves, exploiting power-saving sleep modes, data transmission and reception between two Arduinos, incorporating wireless technologies like Wi-Fi, ZigBee, Bluetooth, GPS, and GSM, leveraging the internet of things (IoT) to transmit and receive sensor data to and from remote locations. This module will teach students the knowledge and skills to utilize microcontrollers in biomedical applications effectively.

Module 43-Elective I

Code	Course/Module Title	ECTS	Semester
MIET4107	Artificial Neural Engineering	4	7
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	60	60
Description			

Artificial neural engineering involves the design and development of artificial neural networks, inspired by the structure and function of the human brain, to solve complex problems and perform tasks such as pattern recognition, data analysis, and decision-making.

Module 44

Code	Course/Module Title	ECTS	Semester
MIET4201	Medical Therapeutic Instrumentation II	7	8
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	136

Description
This module covers the fundamental concepts and principles of many medical therapeutic instruments that are used in hospitals and clinics. The students will understand the different parts of medical therapeutic instrumentation and the idea behind these parts as well as their operation. The student will be able to get the necessary knowledge to diagnose the faults that may occur in each part and manage to fix them as well as develop some alternatives in emergencies. The students may gain skills to design and develop such instrumentations in the healthcare field. Many instruments will be discussed thoroughly like Artificial organs, Mechanical ventilator, anesthesia machine, stereotactic radiosurgery systems and many other important therapeutic instruments.

Module 45

Code	Course/Module Title	ECTS	Semester
MIET4202	Engineering of Radiation Instrumentation	6	8
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	106
Description			
The Engineering of Radiation Instrumentation course focuses on the design and development of instruments used in radiation-related fields. Topics covered include atomic structure and atomic radiation, Radiation detection & engineering of radiation detectors , Engineering of radiation dosimetry and dosimeters . Moreover, the student will understand the Clinical radiation generators., Dose distribution and scatter analysis, Engineering of electron beam therapy, and many other related topics . Students gain practical skills in designing radiation detectors, analyzing data, and implementing radiation measurement systems for applications in nuclear science, medical imaging, and radiation safety.			

Module 46

Code	Course/Module Title	ECTS	Semester
MIET4203	Artificial Limbs and Robotics	6	8
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	4	88	92
Description			
This modules cover the artificial Limbs and robotics which allows for flexible instruments in the surgical platform to be introduced into the body for purposes of performing surgery using motors to orient and move the instruments within a body cavity. The robotics system includes a component(s) through which flexible instruments can be inserted into the body. This component can receive a flexible instrument and use the motors to move the flexible instrument in multiple degrees of freedom. This module presents a system of one or more computer-controlled manipulators and mechanical arms that operates autonomously or is operated remotely (e.g., teleoperated) by a human, including attachable			

components or assemblies that operate as part of (and not separately from) such a system during any medical or surgical diagnosis, treatment, or procedure. Since robotic systems allow the development of minimally invasive endoscopic cardiac surgery. These systems help overcome the difficulties inherent in conventional endoscopic microsurgery. Two robotic systems are currently used in cardiac surgery: (1) the Zeus system developed by Computer Motion (Goleta, CA); and (2) the DaVinci system developed by Intuitive Surgical (Mountain View, CA). The module will introduce students to the fundamentals of robotic systems including kinematics and dynamics as applied to manipulators and mobile robots., learning how to support many application sensors are required, the module will discuss tactile and vision sensing as applied to both fixed and mobile robots. Help students to understand how biological systems have influenced the development of current and future robotic systems, including swarms and humanoid robotic systems. This module is used to provide students with a solid understanding of robotics fundamentals, and to cover their designs and the workspace of robot. Describe and identify the common types of robots and the applications of robot according to their design. It will help students to recognize state-of-the-art systems and methods for robotic and computer-assisted surgeries.

Module 47-Elective II

Code	Course/Module Title	ECTS	Semester
MIET4205	Programmable Logic Devices	4	8
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	60	60
Description			

This module comprehensively explores programmable logic devices (PLDs) fundamental concepts and principles and their wide-ranging applications. Students will develop a thorough understanding of various types of PLDs, encompassing their classifications, architectures, and the programming techniques employed to configure them. They will learn how to design, develop, and implement systems based on PLDs specifically tailored to diverse applications. Key topics covered in this module include Random Access Memories (RAMs), containing Static RAMs (SRAMs) and Dynamic RAMs (DRAMs), Read-Only Memories (ROMs), such as Mask ROMs, Diode Matrix ROMs, EEPROMs, PROMs and flash memories and specialized memory types like FIFO and LIFO, maximal code generation, which comprises maximal code, Gold code, Barker codes, and non-linear codes, combinational logic gates, containing binary adders/subtractors, decoders, and multiplexers, sequential circuits, such as flip-flops and registers, programmable logic array (PLA) and programmable array logic (PAL), a complex programmable logic device (CPLD) and field programmable gate array (FPGA), and programming gates, including AND, NAND, OR, NOR, XOR, and XNOR gates, using the VHDL language. By completing this module, students will acquire the necessary knowledge and skills to effectively employ programmable logic devices in various applications, enabling them to design and implement systems that leverage the capabilities of PLDs.

Module 48-Elective II

Code	Course/Module Title	ECTS	Semester
MIET4206	Biomedical Sensors Networks	4	8
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	60	60

Description
This module comprehensively explores the fundamental concepts and principles related to Biomedical Sensor Networks and their extensive applications in the biomedical field. Students will develop a thorough understanding of Biomedical Sensor Networks, including their various types, topologies, and the performance techniques utilized to configure them. They will learn how to design, develop, and implement systems based on Biomedical Sensor Networks specifically tailored to diverse biomedical applications. Key topics covered in this module include the concept of biomedical sensor networks, biomedical sensors and signal acquisition, sensor data processing and feature extraction, wireless communication protocols such as Bluetooth, Wi-Fi, Zigbee, etc., energy management and power optimization data fusion and integration, localization and tracking within biomedical sensor networks, wearable biomedical sensors for continuous vital sign monitoring, wireless power transfer for implanted devices in sensor networks, internet of things (IoT) and cloud computing in biomedical sensor networks, data analytics and machine learning in biomedical sensor networks, biomedical sensor networks for disease monitoring and management, security and privacy considerations in biomedical sensor networks, emerging trends and future directions in the field. By completing this module, students will acquire the necessary knowledge and skills to utilize Biomedical Sensor Networks in various applications effectively. They will be equipped to design and implement networks that leverage the capabilities of Biomedical Sensor Networks, enabling advancements in the biomedical field.

Module 49- Elective III

Code	Course/Module Title	ECTS	Semester
MIET4207	Biomedical Image Processing	4	8
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	60	60
Description			
The biomedical image processing course explores techniques for analyzing and enhancing medical images. Topics covered include image acquisition, preprocessing, segmentation, registration, and feature extraction. Students learn to apply image processing algorithms to improve image quality, detect anomalies, and extract meaningful information for medical diagnosis and research purposes.			

Module 50- Elective III

Code	Course/Module Title	ECTS	Semester
MIET4208	Statistics for Biomedical Engineering	4	8
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	60	60
Description			
The statistics course provides a foundation in statistical theory and methods. Topics covered include sampling and descriptive statistics, probability, propagation of error. Students learn how to commonly Used Distributions. The student takes knowledge about Confidence			

intervals and hypothesis testing. The course emphasizes the application of statistical methods in various fields, including research, business, and decision-making.

Module 51

Code	Course/Module Title	ECTS	Semester
MIET4204	Professional Ethics	3	8
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	1	45	45
Description			
The Professional Ethics course examines ethical principles and values in professional settings. Topics covered include integrity, confidentiality, responsibility, and ethical decision-making. Students explore real-world case studies and develop ethical reasoning skills to navigate complex professional dilemmas. The course fosters an understanding of ethical responsibilities and promotes ethical behavior in various professions and industries.			

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