Course Title	Biomedical Instrumentation				
Course Code	ABS303				
Course Type	Compulsory				
Level	BSc (Level 1)				
Year / Semester	3rd year / 5th Semester				
Teacher's Name	Dr Constantinos Tatas				
ECTS	6	Lectures / week	3	Laboratories / week	2
Course Objectives	The course aims to introduce students of the undergraduate course in basic principles of electrical/electronic and computer engineering as applied to clinical laboratory instrumentation. Students will be equipped with the background that will enable them to assemble, repair and maintain laboratory instruments, which are widely available in analytical laboratories. The students will be introduced to the stages and components of data acquisition such as transducers, analog and digital signal processing and analog-to-digital conversion as well as the characteristics of instruments, such as accuracy, precision, repeatability and reproducibility, sensitivity and specificity. Students will also be introduced to the process of calibrating an instrument.				
Learning Outcomes	Graduating students will be able to: • evaluate circuit diagrams and understand the role(s) of the different electronic components and their function • assemble optical-bench components, explain their function and understand the rationale for their use • design and trouble-shoot simple electronic circuits appropriate for use in laboratory instrumentation • read C++ programs, develop and implement simple algorithms and data acquisition applications • understand, optimize, calibrate and explain the functions of modern/automated clinical analysers				
Prerequisites	None	Required	None		
Course Content	Theory In analog electronics, students will learn basic physics about voltage and current, basic electrical and electronic components including resistors, diodes, transistors, capacitors, and operational amplifiers. Basic analog passive and active filters and their role in biomedical devices will be discussed. In digital electronics, students will learn the principles behind analog-to-				

	digital conversion and digital filtering, including quantization error and ADC resolution. The application of the above in common biomedical signals such as ECG will be discussed. In computer engineering students will be introduced to the principles of representing information in digital form including images as well as basic image processing and compression principles. The role of digital electronics, and microprocessors in medical devices will be discussed together with principles of computer programming, data processing, flowcharts and algorithms. The limitations of formal algorithms that led to the development of machine learning will be discussed. On optics, the course covers light sources, lenses, mirrors, prisms, wavelength selectors, detectors, polarizing optics and various types of microscopy, as well as other techniques including photometry, colorimetry, chemiluminiscence, flow cytometry chromatography, spectrophotometry, ELISA and PCR. The course includes a series of laboratory exercises that offer the opportunity to students to gain experience with the concepts and topics presented in lectures. The students will become famiiliar with the automated technologies and instruments that are currently used in a modern Clinical Chemistry laboratory. <u>Laboratory exercises:</u> • Individual and small group experiments illustrating the basics of the instrumentation process using basic sensors such as • Individual and small group experiments using instruments used in a modern Clinical Chemistry Laboratory
Teaching Biomedical Instrumentation	The teaching of the course includes lectures to help students understand the theoretical background, and laboratory exercises in order to get a better comprehension of the main concepts of Biomedical Instrumentation and automation in a Clinical Laboratory. Methods such as discussion, questions/answers, and pros/cons, are used to enhance student's participation. PowerPoint and image-rich material and short animations are used to better understand the principles of the course. The laboratory exercises are conducted in University Laboratories as well as affiliated using the appropriate laboratory equipment, under the instructor's supervision. Appropriate preparation and demonstration by the laboratory supervisor precedeseach laboratory exercise. Assessment of laboratory exercises includes laboratory reports submitted by each student at the end of each laboratory exercise. Teaching on the current instrumentation used in Clinical laboratories will be delivered by specialists in Clinical Biochemistry, Hematology, Microbiology, Immunology, Molecular Biology and Histology/Electron Microscopy. Course Indicative Weekly breakdown: Week 1: Introduction to Biomedical Instrumentation: Components of a medical instrument, the process of measurement etc. Week 2: Characteristics of instruments: Types of errors, accuracy, precision, resolution, etc. Week 3: Transducers

	Week 4: Circuit basics: Voltage and current, resistors, capacitors etc. Week 4-5: Signal conditioning: Amplification, analog filters, etc Week 6: Midterm Week 7-8: Digital information. Digital representation of numbers, video and audio signals, images, etc. The Analog to Digital Conversion process. Week 9-10: Digital Signal Processing fundamentals. Week 11: Microprocessor fundamentals and the role of microprocessors/microcontrollers in medical instrumentation Weeks 12-13: Algorithm and programming principles: Flowcharts, pseudo-code, programming languages.
Bibliography	Textbooks: • Andrew G. Webb, "Principles of Biomedical Instrumentation", Cambridge University Press; 1st edition, 2018 • Tatsuo Togawa, Toshiyo Tamura, P. Ake Oberg, "Biomedical Sensors and Instruments", 2nd edition, CRC press, 2011 References: • Raghbir Singh Khandpur, "Compendium of Biomedical Instrumentation", John Wiley & Sons, 2020
Assessment	Course Work 40% • Mid-term Test 20% • Lab reports 20% Final Exam 60% For student evaluation, the overall grade is determined by a written midterm exam (20%), a laboratory grade (20%) and a written final exam (60%). The mid-term exam is carried out between the 6th and 8th week and it mainly includes short-answer questions and problem-solving exercises and examines specific modules of the course. As far as the laboratory grade is concerned, it comprises of the evaluation of the laboratory reports (60% of the laboratory grade) submitted by the students after every experiment and a final laboratory examination (40% of the laboratory grade) which mainly includes short answer questions and problem-solving questions. In their laboratory reports, students are asked to describe the experimental procedure, to evaluate and analyse their results and to answer specific questions. The following criteria are taken into account when evaluating laboratory reports: (a) experimental data collection (30%), (b) data analysis (40%), and application of theory to draw conclusions (30%). The final exam of the course is carried out during the 14th-16th week of each semester and includes short answer questions, decision questions, and problem-solving questions regarding all course modules.

	The final assessment of the students is formative and summative and is assured to comply with the subject's expected learning outcomes and the quality of the course.
Language	Greek, English