AEEE225 - Instrumentation and Measurements

Course Title	Instrumentation and Measurements				
Course Code	AEEE225				
Course Type	Compulsory				
Level	BSc (Level 1)				
Year / Semester	2/1				
Teacher's Name	Dr. Photos Vryonides				
ECTS	5	Lectures / week	3	Laboratories/week	1
Course Purpose	The aim of the course is to familiarize the students with an understanding of fault theory and the process of electrical instrumentation in order to attain knowledge and skills in error estimation, measurement execution and processing in a variety of devices whether analog or digital. Furthermore the course introduces the students to operation and applications of various sensors and transducers as well as signal conditioning.				
Learning Outcomes	By the end of the course, students must be able to: 1. Define the measurement units and the elements of a measurement system and identify appropriate measurement instruments. Review the instrument types and describe the static characteristics of instruments. Describe the errors during the measurement process and identify the sources of error 2. Describe the architecture and working principles of AC/DC meters, oscilloscopes and signal generators. Perform ammeter insertion and voltmeter loading effect error analysis. 3. Classify sensors and transducers and describe the main physical principles used in measurement sensors. Identify the range of sensors and instruments that are available for measuring various physical quantities. 4. Define sources of measurement noise during the measurement process and recognize techniques for reducing measurement noise. Apply appropriate steps for designing a measurement system. 5. Explain the principle of operation of signal conditioning and apply examples of signal filtering, signal amplification, signal attenuation, signal linearization and bias removal.				
Prerequisites	AEEE170	Corequisites			
Course Content	**Introduction to Instrumentation and Measurements:** Principle of Instrumentation and Measurements, Error in Measurement, Measurement Standard, Uncertainties.				

	DC and AC meters : Introduction to DC Meters, d'Arsonval Meter Movement, DC Ammeter, DC Voltmeter, DC Ohmmeter, Introduction to AC Meter, d'Arsonval Meter Movement (half-wave rectification),d'Arsonval Meter Movement (full-wave rectification),Loading Effects of AC Meter. **Oscilloscopes and Signal Generators:** Introduction to Oscilloscope, Architecture of Oscilloscope, Introduction to Signal Generator, Architecture of Signal Generator. **Measuring Devices (Sensors and Transducers): I**ntroduction to Sensors and Transducers, Basic Electrical Sensing Elements, Strain Measurement, Calibration Techniques. **Signal Conditioning**: Introduction to signal conditioning, bridge circuits, amplifiers, protection, filters. **Digital Interfaces in Measurement Systems:** Sampling and the sampling theorem, quantization errors, DACs and ADCs **Laboratory work:** Individual and small group experiments performed with the use of Electronic boards, components, measuring instruments and simulation packages. Experiments include the design, construction on Electronic boards and analysis of the circuits and devices taught in theory. Testing is performed using signal measuring equipment such as digital multimeters, oscilloscopes and spectrum analysers. The performance of the designed circuits is also simulated and the results are evaluated and compared with the experimental analysis.
Teaching Methodology	Students are taught the course through lectures (3 hours per week) in classrooms or lectures theatres, by means of traditional tools or using computer demonstration. Auditory exercises, where examples regarding matter represented at the lectures, are solved and further, questions related to particular open-ended topic issues are compiled by the students and answered, during the lecture or assigned as homework. Topic notes are compiled by students, during the lecture which serve to cover the main issues under consideration and can also be downloaded from the e-learning platform or the lecturer's webpage. Students are also advised to use the subject's textbook or reference books for further reading and practice in solving related exercises. Tutorial problems are also submitted as homework and these are solved during lectures or privately during lecturer's office hours. Furthermore, design projects may be assigned to the students, where literature search is encouraged to identify a specific problem related to some issue, gather relevant scientific information about how others have addressed the problem, implement to implement the design and report the results in written or orally. Laboratory experiments are carried out in small groups and lab reports are required two weeks after the laboratory class resulting in a cumulative mark.
Bibliography	**(e) <u>Textbooks:</u>** • **Robert B.Northrop, Introduction to Instrumentation and Measurements**, 3rd Edition,CRC Press, 2014

	(f) <u>References:</u> • **Curtis D. Johnson, "Process Control Instrumentation Technology"**, 8th Edition, Prentice-Hall, 2014
Assessment	The Students are assessed via continuous assessment throughout the duration of the Semester, which forms the Coursework grade and the final written exam. The coursework and the final exam grades are weighted 40% and 60%, respectively, and compose the final grade of the course. Various approaches are used for the continuous assessment of the students, such as mid-term written exam, oral exam, quizzes, design assignments, design projects and laboratory experiments. The assessment weight, date and time of each type of continuous assessment is being set at the beginning of the semester via the course outline. An indicative weighted continuous assessment of the course is shown below: • Assignments 10% • Homework 10% • Mid-Term written exams 30% • Design Project 20% • Laboratory Work 20% • Quizzes 10% Students are prepared for final exam, by revision on the matter taught, problem solving and concept testing and are also trained to be able to deal with time constrains and revision timetable. The criteria considered for the assessment of each type of the continuous assessment and the final exam of the course are: (i) the comprehension of the fundamental concepts and theory of each topic, (ii) the application of the theory in solving related problems and (iii) the ability to apply the above knowledge in more complex design problems. The above criteria are weighted 30%, 40% and 30%, respectively. 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	**English**