<table>
<tr><td>Course Title</td><td colspan="5">Instrumentation and Software Applications</td></tr>
<tr><td>Course Code</td><td colspan="5">ME211</td></tr>
<tr><td>Course Type</td><td colspan="5">Compulsory</td></tr>
<tr><td>Level</td><td colspan="5">BSc (Level 1)</td></tr>
<tr><td>Year / Semester</td><td colspan="5">2ND / Spring</td></tr>
<tr><td>Teacher's Name</td><td colspan="5">Dr. Konstantinos Tatas</td></tr>
<tr><td>ECTS</td><td>5</td><td>Lectures /week</td><td>3</td><td>Laboratories/ week</td><td>1</td></tr>
<tr><td>Course Purpose</td><td colspan="5">The aim of the course is to introduce students to instrumentation principles and the design of data acquisition systems using MATLAB, LABVIEW and actual sensors. Furthermore, it aims at demonstrating the characteristics of data acquisition systems and the role of each stage in the system, such as signal conditioning, analog to digital conversion, etc.</td></tr>
<tr><td>Learning outcomes</td><td colspan="5">1. Describe the instrumentation principles, elements in real measurement systems and measurement statistics (standard deviation, curves of regression, accuracy, error analysis).
2. Explain the operation and use of basic sensors for measurement of displacement, temperature, force, pressure, flow, and motion
3. Analyse the requirements for signal conditioning, signal amplification, filtering, and the effects of noise, grounding and differential signals
4. Analyse the performance of a variety of measuring instruments in terms of accuracy, precision, resolution, hysteresis, reproducibility and sensitivity and perform calibration techniques on these instruments.
5. Design, through laboratory sessions, virtual instruments for data acquisition, processing, measurement, analysis and presentation, using graphical programming languages such as LABVIEW.
6. Employ the computer programming language Matlab to solve different matrix operations and systems of linear equations, to compute eigenvalues and eigenvectors, to execute elementary vector manipulation, to exhibit linear transformations and to construct plots.</td></tr>
<tr><td>Prerequisites</td><td colspan="2">AEEE103, AMAT204</td><td colspan="2">Co-requisites</td><td>None</td></tr>
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Course contents:	• **Instrumentation principles:** Describe the structure of a general measuring system and understand the role of each component part. Describe how a measuring system is calibrated and define characteristics of instruments such as: resolution and readability. Calculate the sensitivity, percentage error, possible error and probable error for a measuring system • **Sensors and transducers:** Understand the operation principles of sensors and transducers. Describe various types of displacement, position and proximity sensors. Solve problems regarding strain gauges, potentiometers and differential transformers. Describe how resistance temperature sensors and thermocouples work. Solve problems with RTD and thermistors. • **Signal conditioning:** Understand the role of signal conditioning as part of a measuring system and define signal amplification ,filtering, noise, grounding and differential signals.Describe the operation principles of mechanical and electronic amplifiers. Calculate the gain (amplification) for various types of amplifiers. • **Lab Work:** Use effectively all editing techniques of LabVIEW in both, front panel and block diagram environment.Create simple virtual instruments. Develop a virtual instrument which simulates signal generation and processing. Create a subVI which converts temperature units. Design an icon-connector and use it in a VI. Perform data acquisition using LabVIEW. Understand how to use loops for counting. Analyze logging data. Create a source file which calculates the minimum, maximum, and average temperatures during acquisition process and displays all measurements in real time on a waveform graph. Use strain gauges as arms of a Wheatstone bridge for measuring displacement. Perform measurements with linear and rotary potentiometers. Understand the operation of an optical encoder. Calculate the rotational speed of a shaft using either the Gray scale or the Binary Scale Encoder. • **MATLAB Applications.** Basic matrix algebra, the determinant of a matrix of norder, solving simultaneous equations with n unknowns with a number of techniques, finding eigenvalues and eigenvectors. Elementary vector manipulation, finding linear dependence. Linear Transformations, plotting transforms on the x-y plane.
Teaching Methodology	Most part of course is delivered to the students by means of lectures and tutorials conducted with the help of power point presentations and hand notes. Lecture notes and presentations are available through the web (extranet) for students to use in combination with the textbooks. Laboratory experiments are carried out in small groups using common sensors. Furthermore, computer Laboratories are utilized for special Matlab and

	LABVIEW sessions, where students learn how to use Matlab and LABVIEW effectively, develop the functional units taught in lectures and gain greater insight into the underline mathematics. Several examples and exercises are solved in class to practice the theory and methodology taught. Students work on their own during class hours on examples and practice problems. Extra assignments are given to students to tackle at home, including exercises using MATLAB.
Bibliography	**Textbooks**: • Franklyn Kirk, Instrumentation and Process Control 6th Edition, ATP, 2014 **References** • Jeffrey Travis, LabVIEW for Everyone, 3rd edition, Prentice Hall, 2007. • Anton H., *Contemporary Linear Algebra MATLAB Technology Resource Manual*, John Wiley, 2002
Assessment	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. In order to continuously assess students, coursework weight is set at 40%, which comprises assignments, a mid-term exam and laboratory work assessment. Assignments range from simple problems to work out, to LABVIEW and MATLAB assignments that require concept understanding as well as problem-solving skills. 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% • Tests: 10% • Laboratory Work: 20% • Final Exam: 60%
Language	English