Course Title	Circuits and Electronics II & Laboratory				
Course Code	ECE220				
Course Type	Compulsory				
Level	Bachelor (1st Cycle)				
Year / Semester	2rd Year / 4th Semester				
Teacher's Name	TBA				
ECTS	12	Lectures / week	3 hours / 14 weeks	Laboratories / week	3 hours / 14 weeks
Course Purpose and Objectives	This course introduces students to solid state electronics. It presents semiconductors, diodes, and transistors. Basic transistor circuits for amplifiers and switches are analyzed in detail. The use of the operational amplifier as the basic building block for analogue electronic systems are presented. Various applications of the operational amplifier are examined. The Field-Effect Transistor is also presented. During the laboratory part, the students will have the opportunity to gain better understanding of the theoretical part, by carrying out a sequence of related experiments.				
Learning Outcomes	Upon successful completion of this course, students should be able to: • Describe the basics of semiconductors and diodes and design and analyze circuits for voltage rectification and regulation using diodes. • Illustrate the operation and properties of NPN and PNP transistors, including I-V characteristics, regions of operation, equivalent circuit models and their limitations, and transfer characteristic with a load resistor • Illustrate the operation and properties of nMOS (n-type metal-oxide semiconductor) and pMOS field-effect transistors, including I-V characteristics, regions of operation, equivalent circuit models and their limitations, enhancement-mode and depletion-mode devices, and transfer characteristic with a load resistor. • Describe the basics of operational amplifiers and examine the operation of a differential and ideal operational amplifier. • Recognise negative / positive feedback and explain its effects on an amplifier and explain both linear and non-linear applications of the operational amplifier. • Describe active filter circuits.				
Prerequisites	ECE205		Co-requisites	None	

Course Content	**Theoretical part** Diodes: Semiconductor diodes, diode characteristic, the Zener diode and voltage regulation, variable capacitance diodes. Full-rectified power supplies: Application of the junction diode for voltage rectification and power supply design. Voltage regulation. Integrated circuit voltage regulators. Introduction to switching mode power supplies. Bipolar junction transistor characteristics: The bipolar junction transistor, NPN and PNP types. Common base, common emitter and common collector configurations. Transistor biasing: The various methods for dc biasing of a transistor, mostly for the common emitter configuration. The DC operating point, dc load line. The cut-off and saturation regions. Small signal transistor amplifiers: The use of a transistor for a single stage small signal amplifier. The ac load line. Coupling capacitors. Multi-stage transistor amplifiers. Introduction to cascading stages for increasing the gain. Frequency response: Amplifier frequency response. The Bode plot for the gain and the phase shift of an amplifier. Push-Pull class B amplifiers: Introduction to the push-pull configuration for class B transistor amplifiers. Biasing. Amplifier power efficiency. Field Effect Transistors: Introduction to the Junction Field Effect Transistor (JFET). Basic operation. The biased JFET. Drain curves and the tranconductance curve. JFET approximations. The Metal Oxide Semiconductor FET (MOSFET). Depletion mode and enhancement mode MOSFETs. FET amplifiers and switches: The use of the JFET as the basic building block for simple small-signal amplifiers. The JFET as an analogue switch. Depletion mode MOSFET amplifiers. Enhancement mode MOSFET applications. Differential amplifiers: The differential amplifier configuration. Detailed analysis of its operation. Properties and characteristics of the differential amplifier. OP-AMP characteristics: The ideal characteristics of the operational amplifier. Input and output impedance, open loop gain and bandwidth. Temperature stability, offset currents and voltages. Output offset voltage, common mode gain. OP-AMP amplifiers: The inverting configuration. The non-inverting configuration. Analysis and design of simple circuits. Closed loop gain calculations. Small signal frequency response OP-AMP application circuits: The use of the op-amp in adder and mixer circuits. Integrators and differentiators. Review of the necessary conditions for oscillation.

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<tr><td></td><td>Active filter design: The OP-AMP as the active element in active filters. Low-pass, high-pass, band-pass, and band-stop filters. First degree and second degree transfer functions. Analysis of the characteristic equation.
Laboratory part
The laboratory part of the course comprises of a set of experiments which complement the theoretical material covered in class. The experiments focus on the basics of semiconductor devices and their applications and analyse experimentally circuits involving diodes, transistor and transistor amplifier circuits, differential amplifiers, operational amplifiers and active filters.</td></tr>
<tr><td>Teaching Methodology</td><td>Face - to - face</td></tr>
<tr><td>Bibliography</td><td>Malvino, A. P., Electronic Principles, McGraw-Hill
Stanley, William D., Operational Amplifiers with Linear Integrated Circuits, Prentice Hall/MacMillan
Floyd, Thomas L., Basic Operational Amplifiers and Linear Integrated Circuits, Prentice Hall/MacMillan
Millman, J., Halkias, C., Integrated Electronics, Analogue and Digital Circuits ans Systems, McGraw-Hill
Millman, J., Microelectronics, Digital and Analogue Circuits and Systems, McGraw-Hill
Fortney, Lloyd, Principles of Electronics, Analogue and Digital, Oxford University Press
Alley, Charles L. Atwood, Kenneth W., Microelectronics, Prentice-Hall International Editions
Lab-Volt, FACET Computer based Laboratory</td></tr>
<tr><td>Assessment</td><td><table><tr><td>Examination</td><td>55%</td></tr><tr><td>Assignments/Lab</td><td>35%</td></tr><tr><td>Class Participation and Attendance</td><td>10%</td></tr><tr><td></td><td>100%</td></tr></table></td></tr>
<tr><td>Language</td><td>English</td></tr>
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