Syllabus

Course Description

Course Title	Electronics
Course Code	42428
Course Title Additional	
Scientific-Disciplinary Sector	
Language	Italian
Degree Course	Bachelor in Electronics and Cyber-Physical Systems Engineering
Other Degree Courses (Loaned)	
Lecturers	Prof. Luisa Petti, Luisa.Petti@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/39580 dr. Giuseppe Ciccone, Giuseppe.Ciccone@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/49145 Dott. Alessandro Torrisi, Alessandro.Torrisi@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/49858
Teaching Assistant	Dott. Alessandro Alleva
Semester	All semesters
Course Year/s	2
CP	12
Teaching Hours	72
Lab Hours	48
Individual Study Hours	180
Planned Office Hours	36
Contents Summary	M1 • Fundamentals of electrical engineering: electrical quantities, concept of bipoles and quadripoles; ideal and real generators;

	Kirchhoff's laws. • Resistive circuits and adynamic bipoles: resistive bipoles and Ohm's law; Thevenin's and Norton's equivalent circuits; nodal analysis and circuit simplification; superposition principle. • Dynamic circuits and transient response: introduction to dynamic bipoles; first and second order circuits; transient response and time-domain analysis. • Sinusoidal circuit analysis: superposition in AC circuits; multi-frequency circuits and signal decomposition; Thevenin's and Norton's models in AC; nodal analysis in sinusoidal regimes. • Power in sinusoidal mode: instantaneous and average power calculations; root mean square (RMS) values, complex power and power factor considerations. • Biports and circuit interconnections: biports and their characteristics; connection methods and practical applications; analysis of biport circuits in both dynamic and sinusoidal regimes • Operational amplifiers: principles and working of op-amps; circuit configurations and feedback mechanism; analysis of op-amp circuits in dynamic and sinusoidal conditions. • Frequency response and filters: transfer function and system behaviour; Decibel scale and Bode diagrams; design and analysis of filters. • Circuit simulation with SPICE: introduction to SPICE as a simulation tool; modelling and analysis of electrical components; practical applications in circuit design. M2 • Diodes: models, rectifier circuits, diode-based voltage regulators, limiting and clamping circuits. • Operational amplifiers: advanced circuits, difference amplifiers, integrators and differentiators, Op-Amp filters and non-idealities, positive feedback. • MOSFET and BJT models: physical structure, I-V model, C-V model, parasitic capacitances and resistances, small-signal models, p-channel MOSFET, pnp BJT. • Transistor amplifiers: basic principles, basic configurations, biasing networks, discrete-circuit and IC amplifiers. Differential amplifiers: differential pair.

	• Frequency response: low- and high-frequency responses, high-frequency response of MOSFET amplifiers. • Digital logic circuits: elements of Boolean algebra and combinatorial logic. CMOS logic circuit topologies, dynamic operation, and power dissipation.
Course Topics	M1 • Fundamentals of electrical engineering: electrical quantities, concept of bipoles and quadripoles; ideal and real generators; Kirchhoff's laws. • Resistive circuits and adynamic bipoles: resistive bipoles and Ohm's law; Thevenin's and Norton's equivalent circuits; nodal analysis and circuit simplification; superposition principle. • Dynamic circuits and transient response: introduction to dynamic bipoles; first and second order circuits; transient response and time-domain analysis. • Sinusoidal circuit analysis: superposition in AC circuits; multi-frequency circuits and signal decomposition; Thevenin's and Norton's models in AC; nodal analysis in sinusoidal regimes. • Power in sinusoidal mode: instantaneous and average power calculations; root mean square (RMS) values, complex power and power factor considerations. • Biports and circuit interconnections: biports and their characteristics; connection methods and practical applications; analysis of biport circuits in both dynamic and sinusoidal regimes • Operational amplifiers: principles and working of op-amps; circuit configurations and feedback mechanism; analysis of op-amp circuits in dynamic and sinusoidal conditions. • Frequency response and filters: transfer function and system behaviour; Decibel scale and Bode diagrams; design and analysis of filters. • Circuit simulation with SPICE: introduction to SPICE as a simulation tool; modelling and analysis of electrical components; practical applications in circuit design. M2 • Diodes: models, rectifier circuits, diode-based voltage regulators, limiting and clamping circuits. • Operational amplifiers: advanced circuits, difference amplifiers,

	integrators and differentiators, Op-Amp filters and non-idealities, positive feedback. • MOSFET and BJT models: physical structure, I-V model, C-V model, parasitic capacitances and resistances, small-signal models, p-channel MOSFET, pnp BJT. • Transistor amplifiers: basic principles, basic configurations, biasing networks, discrete-circuit and IC amplifiers. Differential amplifiers: differential pair. • Frequency response: low- and high-frequency responses, high-frequency response of MOSFET amplifiers. • Digital logic circuits: elements of Boolean algebra and combinatorial logic. CMOS logic circuit topologies, dynamic operation, and power dissipation.
Keywords	Electrotechnics, Electronics, Electronic Circuits
Recommended Prerequisites	Mathematical Analysis I, Linear Algebra, Physics I, Physics II (For M1) + Mathematical Analysis I, Linear Algebra, Physics I, Physics II, Electronic Devices (for M2)
Propaedeutic Courses	none
Teaching Format	Frontal lectures & labs/workshop.
Mandatory Attendance	Attendance is not compulsory, but highly recommended as many labs require adequate software and hardware infrastructure; non-attending students may contact the lecturer at the start of the course to get support on the modalities of the independent study
Specific Educational Objectives and Learning Outcomes	M1: Knowledge and understanding The student knows the concept of a circuit model and its fundamental components as well as the fundamental laws and theorems (including their limits of validity) necessary to analyze a circuit. Applying knowledge and understanding The student is able to use the knowledge acquired to create circuit models and analyze circuits. Making judgments The student is able to select from the various tools provided by the

	course those most suitable for achieving the objectives in terms of modeling and analysis of electrical circuits. Communication skills The student is able to present the competencies acquired with vocabulary appropriate to the topic. Learning skills The student is able to use the tools and reasoning techniques acquired to extend his/her knowledge. M2 Knowledge and understanding in the field of: Thanks to training in Electronic Engineering, graduates in Electronic and Cyber-Physical Systems Engineering will be able to: know and understand the fundamental principles, techniques and methods of designing, prototyping and testing basic analog and digital electronic circuits; Applying knowledge and understanding Ability Thanks to training in Electronic Engineering, graduates in Electronic and Cyber-Physical Systems Engineering will be able to: - apply the knowledge of Electronics to analyze and understand the behavior of analog and digital circuits, using the most appropriate approximations; - carry out simple experimental activities on electronic systems, acquiring measurements relating to the system and its behavior. Making judgements The graduate has the ability to judge and discern between different solutions to problems, evaluating the alternatives and methodologies to be applied, regarding fundamental analog and digital electronic circuits. The graduate has the ability to participate in data collection, analysis and the formulation of critical judgments and project

	proposals. Communication skills The graduate is able to communicate, understand and process texts on technical issues. In this case, not only the contents of the essay will be evaluated, but also the candidate's synthesis, communication and presentation skills. Ability to learn The graduate acquires the methodological tools for study and further exploration, including independent study, and possesses the knowledge necessary to undertake subsequent levels of university education (master's degree or first-level master's program)
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	Written and oral exam, with written evaluation "in itinere" , possible project assignment for evaluation
Evaluation Criteria	The evaluation criteria will be: - the accuracy of the answers given in the written examination, with particular attention to the resolution procedure adopted and the formal correctness of the same. - The accuracy of the answers given in the oral examination, with particular attention to the terminology used.
Required Readings	M1: Circuiti elettrici", Charles K. Alexander, Matthew Sadiku, Giambattista Gruosso, Giancarlo Storti Gajani. M2: Adel S. Sedra, Kenneth C. Smith, "Microelectronic Circuits," Oxford University Press, 7th ed. (other editions are equally acceptable)

Supplementary Readings	Paul Horowitz, Winfield Hill, "The Art of Electronics", Cambridge University Press, 2nd Edition (other new editions are equally acceptable)
Further Information	Assessment language: ITALIAN Software used: LTspice
Sustainable Development Goals (SDGs)	Industry, innovation and infrastructure, Quality education

Course Module

Course Constituent Title	Basics of Electronics
Course Code	42428A
Scientific-Disciplinary Sector	IINF-01/A
Language	Italian
Lecturers	Prof. Luisa Petti, Luisa.Petti@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/39580 dr. Giuseppe Ciccone, Giuseppe.Ciccone@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/49145
Teaching Assistant	Dott. Alessandro Alleva
Semester	First semester
CP	6
Responsible Lecturer	
Teaching Hours	36
Lab Hours	24
Individual Study Hours	90
Planned Office Hours	18
Contents Summary	• Fundamentals of electrical engineering: electrical quantities, concept of bipoles and quadripoles; ideal and real generators; Kirchhoff's laws. • Resistive circuits and adynamic bipoles: resistive bipoles and Ohm's law; Thevenin's and Norton's equivalent circuits; nodal analysis and circuit simplification; superposition principle.

	• Dynamic circuits and transient response: introduction to dynamic bipoles; first and second order circuits; transient response and time-domain analysis. • Sinusoidal circuit analysis: superposition in AC circuits; multi-frequency circuits and signal decomposition; Thevenin's and Norton's models in AC; nodal analysis in sinusoidal regimes. • Power in sinusoidal mode: instantaneous and average power calculations; root mean square (RMS) values, complex power and power factor considerations. • Biports and circuit interconnections: biports and their characteristics; connection methods and practical applications; analysis of biport circuits in both dynamic and sinusoidal regimes • Operational amplifiers: principles and working of op-amps; circuit configurations and feedback mechanism; analysis of op-amp circuits in dynamic and sinusoidal conditions. • Frequency response and filters: transfer function and system behaviour; Decibel scale and Bode diagrams; design and analysis of filters. • Circuit simulation with SPICE: introduction to SPICE as a simulation tool; modelling and analysis of electrical components; practical applications in circuit design.
Course Topics	• Fundamentals of electrical engineering: electrical quantities, concept of bipoles and quadripoles; ideal and real generators; Kirchhoff's laws. • Resistive circuits and adynamic bipoles: resistive bipoles and Ohm's law; Thevenin's and Norton's equivalent circuits; nodal analysis and circuit simplification; superposition principle. • Dynamic circuits and transient response: introduction to dynamic bipoles; first and second order circuits; transient response and time-domain analysis. • Sinusoidal circuit analysis: superposition in AC circuits; multi-frequency circuits and signal decomposition; Thevenin's and Norton's models in AC; nodal analysis in sinusoidal regimes. • Power in sinusoidal mode: instantaneous and average power calculations; root mean square (RMS) values, complex power and power factor considerations. • Biports and circuit interconnections: biports and their characteristics; connection methods and practical applications; analysis of biport circuits in both dynamic and sinusoidal regimes • Operational amplifiers: principles and working of op-amps;

	circuit configurations and feedback mechanism; analysis of op-amp circuits in dynamic and sinusoidal conditions. • Frequency response and filters: transfer function and system behaviour; Decibel scale and Bode diagrams; design and analysis of filters. • Circuit simulation with SPICE: introduction to SPICE as a simulation tool; modelling and analysis of electrical components; practical applications in circuit design.
Teaching Format	Frontal lectures & labs/workshop.
Required Readings	M1: Circuiti elettrici", Charles K. Alexander, Matthew Sadiku, Giambattista Gruosso, Giancarlo Storti Gajani.
Supplementary Readings	Paul Horowitz, Winfield Hill, "The Art of Electronics", Cambridge University Press, 2nd Edition (other new editions are equally acceptable)

Course Module

Course Constituent Title	Electronic Circuit Design
Course Code	42428B
Scientific-Disciplinary Sector	IINF-01/A
Language	Italian
Lecturers	Dott. Alessandro Torrisi, Alessandro.Torrisi@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/49858
Teaching Assistant	
Semester	Second semester
CP	6
Responsible Lecturer	
Teaching Hours	36
Lab Hours	24

Individual Study Hours	90
Planned Office Hours	18
Contents Summary	• Diodes: models, rectifier circuits, diode-based voltage regulators, limiting and clamping circuits. • Operational amplifiers: advanced circuits, difference amplifiers, integrators and differentiators, Op-Amp filters and non-idealities, positive feedback. • MOSFET and BJT models: physical structure, I-V model, C-V model, parasitic capacitances and resistances, small-signal models, p-channel MOSFET, pnp BJT. • Transistor amplifiers: basic principles, basic configurations, biasing networks, discrete-circuit and IC amplifiers. Differential amplifiers: differential pair. • Frequency response: low- and high-frequency responses, high-frequency response of MOSFET amplifiers. • Digital logic circuits: elements of Boolean algebra andcombinatorial logic. CMOS logic circuit topologies, dynamic operation, and power dissipation
Course Topics	• Diodes: models, rectifier circuits, diode-based voltage regulators, limiting and clamping circuits. • Operational amplifiers: advanced circuits, difference amplifiers, integrators and differentiators, Op-Amp filters and non-idealities, positive feedback. • MOSFET and BJT models: physical structure, I-V model, C-V model, parasitic capacitances and resistances, small-signal models, p-channel MOSFET, pnp BJT. • Transistor amplifiers: basic principles, basic configurations, biasing networks, discrete-circuit and IC amplifiers. Differential amplifiers: differential pair. • Frequency response: low- and high-frequency responses, high-frequency response of MOSFET amplifiers. • Digital logic circuits: elements of Boolean algebra andcombinatorial logic. CMOS logic circuit topologies, dynamic operation, and power dissipation
Teaching Format	Frontal lectures & labs/workshop.
Required Readings	M2: Adel S. Sedra, Kenneth C. Smith, “Microelectronic Circuits,” Oxford

	University Press, 7th ed. (other editions are equally acceptable)
Supplementary Readings	Paul Horowitz, Winfield Hill, “The Art of Electronics”, Cambridge University Press, 2nd Edition (other new editions are equally acceptable)