SYLLABUS

1. Data about the program of study

1.1 Institution	The Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Automation and Computer Science
1.3 Department	Computer Science
1.4 Field of study	Computer Science and Information Technology
1.5 Cycle of study	Bachelor of Science
1.6 Program of study / Qualification	Computer science / Engineer
1.7 Form of education	Full time

2. Data about the subject

2.1 Subject name	***Analog and digital circuits***			Subject code	**17**
2.2 Course responsible / lecturer	Assoc. prof. dr. eng. Iancu Bogdan - Bogdan.Iancu@cs.utcluj.ro				
2.3 Teachers in charge of seminars / Laboratory / project	Assoc. prof. dr. eng. Peculea Adrian - Adrian.Peculea@cs.utcluj.ro Assoc. prof. dr. eng. Iancu Bogdan - Bogdan.Iancu@cs.utcluj.ro				
2.4 Year of study	II	2.5 Semester	3	2.6 Type of assessment (E - exam, C - colloquium, V – verification)	E
2.7 Subject category	Formative category: DF – fundamental, DS – speciality, DC – complementary				DF
	Optionality: DOB – mandatory, DOP – optional (alternative), DFA – optional (free choice)				DOB

3. Estimated total time

3.1 Number of hours per week	4	of which:	Course	2	Seminars	-	Laboratory	2	Project	-
3.2 Number of hours per semester	56	of which:	Course	28	Seminars	-	Laboratory	28	Project	-
3.3 Individual study:										
(a) Manual, lecture material and notes, bibliography										10
(b) Supplementary study in the library, online and in the field										12
(c) Preparation for seminars / laboratory works, homework, reports, portfolios, essays										14
(d) Tutoring										2
(e) Exams and tests										6
(f) Other activities:										-

3.4 Total hours of individual study (suma (3.3(a)...3.3(f)))	44
3.5 Total hours per semester (3.2+3.4)	100
3.6 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1 Curriculum	
4.2 Competence	Basic knowledge in Physics, Electronics, Mathematics

5. Requirements (where appropriate)

5.1. For the course	Blackboard, projector, computer
5.2. For the applications	Classroom, PC with internet access, specific software, test boards, multimeters, voltage sources, signal generators, oscilloscopes, Arduino compatible development kits. Laboratory attendance is mandatory.

6. Specific competence

6.1 Professional competences	**C2:** Designing hardware, software and communication components **C2.1:** Describing the structure and functioning of computational, communication and software components and systems • **C2.2:** Explaining the role, interaction and functioning of hardware, software and communication components • **C2.3:** Building the hardware and software components of some computing systems using algorithms, design methods, protocols, languages, data structures, and technologies • **C2.4:** Evaluating the functional and non-functional characteristics of the computing systems using specific metrics • **C2.5:** Implementing hardware, software and communication systems
6.2 Cross competences	N/A

7. Expected Learning Outcomes

Knowledge	Describes, identifies, and summarizes basic concepts and methods related to systems in general, and to analog and digital systems in particular, as well as their application in concrete problems, namely: • Basic concepts of electrical signals and analog and digital electronic circuits; • Fundamental semiconductor devices (diodes, bipolar transistors, and field-effect transistors); • Architecture and operation of operational amplifiers and feedback circuits; • Structure and operation of power supply circuits, rectifiers, filters, and voltage stabilizers; • Families of integrated logic circuits (TTL, NMOS, CMOS) and their characteristics; • Architecture of digital systems and microcontrollers used in embedded systems.
Skills	Identifies analog and digital electronic components and their role in circuits; Describes the operation of fundamental electronic circuits and digital systems; Uses methods for measuring electrical quantities and identifies analog and digital electronic devices; Analyzes, designs, implements, diagnoses, and debugs digital electronic systems based on the studied theories.
Responsibilities and autonomy	Implements processes from computer and information technology project management, assuming different roles within a team and clearly and concisely communicating, both orally and in writing, the results.

8. Discipline objective (as results from the *key competences gained*)

8.1 General objective	The main objective of this course is to familiarize students with the fundamental principles of analog and digital electronics and to prepare them for carrying out projects using discrete electronic devices and analog and digital integrated circuits. Thus, the course aims to develop the ability to analyze, design, and implement electronic systems used in computer architecture and embedded systems.
8.2 Specific objectives	• Acquisition of theoretical knowledge regarding discrete electronic devices • Development of skills for the design and implementation using discrete electronic devices • Acquisition of theoretical knowledge regarding analog integrated circuits • Development of skills for the design and implementation using analog integrated circuits • Acquisition of theoretical knowledge regarding digital integrated circuits Development of skills for the design and implementation using digital integrated circuits

9. Contents

9.1 Lectures	Hours	Teaching methods	Notes
Introduction. Electrical signals, passive devices, linear circuits behavior at elementary signals application.	2	Oral Presentations using multimedia means Q & A Interactive teaching	
Semiconductor devices (I). Semiconductor, Schottky, Zener and light emitting diode.	2		
Semiconductor devices (II). Bipolar and field effect transistor.	2		
Operational amplifiers. Characteristics, circuits with operational amplifiers with negative feedback.	2		
DC power supplies. Rectifiers, filters. Parametric, feedback and integrated voltage regulators. Oscillators. Positive feedback, oscillator circuits.	2		
Integrated logic circuit parameters. Static transfer characteristics, noise margins, fan-in and fan-out, propagation time, power dissipation.	2		
Integrated logic circuit families (I). TTL integrated logic circuits.	2		
Integrated logic circuit families (II). NMOS, CMOS and HCT integrated logic circuits.	2		
Bus building with logic circuits. Open collector and three state integrated logic circuits, connecting circuits to buses, transfer between registers and three state logic.	2		
Positive feedback circuits (I). Schmitt trigger and flip-flop circuits.	2		
Positive feedback circuits (II). Monostable and astable circuits.	2		
Semiconductor memories. Volatile and non-volatile semiconductor memories.	2		
Converters. Sampling, signal quantization, analog to digital and digital to analog converters.	2		
Microcontrollers. Architecture, memory addressing, interrupt and timer system, serial communication.	2		

Bibliography

1. V. Dadarlat, A. Peculea, „Circuite analogice si numerice”, Ed. U.T.PRES, Cluj-Napoca, 2006
2. Slides for Analog and digital circuits courses + sets of problems and applications for individual study at https://moodle.cs.utcluj.ro/
3. A. Sedra, K.C. Smith, T.C. Carusone, Vincent Gaudet, “Microelectronic Circuits”, Oxford University Press, 8th edition, 2019.
4. P. Horowitz, W. Hill, “The Art of Electronics 3rd Edition”, Cambridge University Press, 2015
5. W. Oskay, E. Schlaepfer, “Open Circuits: The Inner Beauty of Electronic Components”, No Starch Press, 2022

9.2 Applications - Seminars / Laboratory / Project	Hours	Teaching methods	Notes
Linear circuits with RC elements	2	Practical exercises Brief presentation of possible solutions Self testing programmes. Q & A .	
Rectifiers	2		
Continuous voltage sources	2		
Inverter with bipolar transistors	2		
TTL logic circuits	2		
NMOS integrated circuits	2		
CMOS integrated circuits	2		
CMOS transmission gate	2		
Bus design using open collector logic and three state circuits	2		
Measurements using multimeters	2		
RC filters - practical assembly	2		
The study of bipolar transistors - practical assembly	2		

Introduction to Arduino	2		
Laboratory test	2		

Bibliography

1. Slides for Analog and digital circuits courses + sets of problems and applications for individual study at ftp://ftp.utcluj.ro/pub/users/dadarlat/circ_analognumeric-calc and/or https://moodle.cs.utcluj.ro/
2. Adrian Peculea, Bogdan Iancu, Vasile Dadarlat, Sorin Buzura, "Analog and digital Circuits.Practical applications", ISBN 978-606-737-459-9, U.T. Press Cluj-Napoca, 2020

**Se vor preciza, după caz: tematica seminariilor, lucrările de laborator, tematica și etapele proiectului.*

10. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

Course content is kept state of the art by using latest technologies and devices available on the market. The discipline is important for design using discrete electronic devices, and analog and digital integrated circuits. The content of the discipline was discussed with important actors in this field, both academic and industrial, from Romania, Europe and the USA. Discipline was evaluated and certified by ARACIS.

11. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	Interactivity and initial preparation, attendance, activity during lectures, examinations	Written and / or oral exam	60%
Seminar	-	-	-
Laboratory	Interactivity and initial preparation, quality of practical work, ability to solve problems specific to the field, attendance, activity during classes	Continuous assessment / weekly tests, final test - written and / or oral	40%
Project	-	-	-

Minimum standard of performance: Design of electronic systems using discrete devices and analog and digital integrated circuits.
Grade calculus: 40% laboratory + 60% final exam
Conditions for participating in the final exam: Laboratory ≥ 5 Conditions for promotion: grade ≥ 5

Date of filling in:	**Responsible**	**Title, First name Last name**	**Signature**
	Course	Assoc.prof.dr.eng. Bogdan IANCU	
	Applications	Assoc.prof.dr.eng. Adrian PECULEA	
		Assoc.prof.dr.eng. Bogdan IANCU	

Date of approval in the department	Head of department, Prof.dr.eng. Rodica Potolea
Date of approval in the Faculty Council	Dean, Prof.dr.eng. Vlad Mureșan