INSTITUTE OF ELECTRONICS AND INFORMATION TECHNOLOGIES

Subject

Design of Digital Devices

Link to the curricula

Study unit code BK27 **2024**

Level	Study program or it's part	Year	Semester
1	COMPUTER ENGINEERING	4	Spring

ECTS credits	5
Hours - Lectures	**20**
Hours - Laboratory Work	20
Hours - Practical, Seminars	
Hours - Individual Student's Work	110

Lecturers

Assoc. prof. PhD Andri Rogovenko

Languages - lectures	**English**
Languages - tutorial	**English**

Prerequisites

The study of which must precede the study of this discipline: • Physics. • Mathematical analysis. • Discrete Math. • Fundamentals of electrical engineering. • Programming. • Data structures and algorithms. • Computer logic. • Computer electronics. • Software engineering. • Computer modeling. • Digital signal processing.

Content (Syllabus outline)

The subject of studying are: Digital design methodology • Coding styles of VHDL • Synthesis of digital devices • Mapping of logic circuits to transistor-level circuits • Case studies for VHDL

Textbooks

Harris, D., & Harris, S. L. (2012). Digital Design and Computer Architecture (2nd ed.). Morgan Kaufmann. Ashenden, P. J. (2007). *Digital Design: An Embedded Systems Approach Using Verilog*. Morgan Kaufmann.
Verilog HDL: A Guide to Digital Design and Synthesis; Samir Palnitkar; 2nd edition, Pearson Education, 2011.

Objectives

This course describes the process of designing ASICs and FPGAs. It also introduces various design methodologies, such as top-down and bottom-up approaches. Students will learn different coding styles that can be used in VHDL for developing and synthesizing digital circuits. The correctness of the design needs to be verified using various input templates. Thus, students will also learn testbench strategies for verifying the correctness of the design. The course covers several examples, including important arithmetic blocks of digital systems, demonstrating how to design and test digital devices using Verilog HDL. Additionally, it discusses mapping Verilog HDL to logic gates, showing how Verilog HDL constructs are converted into logic gates and their interconnections. Finally, the course provides a brief introduction to how gate-level designs are transformed into

Intended learning outcomes - knowledge and understanding

Upon completing this course, the student will be able to: Understand and analyze the ASIC and FPGA design flow, as well as VLSI methodology. Design digital systems using Hardware Description Language (HDL). Develop test cases for simulation and verification of the design correctness. Convert Hardware Description Language into a gate-level netlist. Implement optimized digital circuits using various HDL-based techniques. Design circuits by applying knowledge of translating logical circuits into transistor-level schematics.

Intended learning outcomes - transferable/key skills and other attributes'

Communication skills: writing professional reports on completed tasks, oral defense of lab work, and expression skills in written examinations. Use of information technology: utilizing software tools for the creation, verification, and simulation of digital devices designs.

Learning and teaching methods

• Lectures, • lab work, • practical assignment.

Assessment	Weight (%)	
Lab work	50	
Practical assignment	50	

Comments

INSTITUTE OF ELECTRONICS AND INFORMATION TECHNOLOGIES

Subject

Systems on Chip

Link to the curricula

Study unit code BK27 **2024**

Level	Study program or it's part	Year	Semester
1	COMPUTER ENGINEERING	4	Spring

ECTS credits	5
Hours - Lectures	**22**
Hours - Laboratory Work	18
Hours - Practical, Seminars	
Hours - Individual Student's Work	110

Lecturers

Assoc. prof. PhD Andri Rogovenko

Languages - lectures	**English**
Languages - tutorial	**English**

Prerequisites

Working knowledge of C, including software development and debugging. Computer system design and hardware/software interfacing. Digital hardware design and hardware description languages

Content (Syllabus outline)

The subject of studying are: Hardware/software co-design: partitioning, real-time scheduling, hardware acceleration. Virtual prototyping: electronic system-level languages and hardware/software co-simulation. High-level synthesis: allocation. SoC integration: SoC communication architectures, IP interfacing, verification and test. FPGA prototyping of hardware/software systems

Textbooks

David Harris, Sarah Harris, Digital Design and Computer Architecture, Second Edition – 2013 Elsevier Ink. - P. Marwedel, Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, Third Edition, Springer, 2018. - D. C. Black, J. Donovan, B. Bunton, A. Keist, SystemC: From the Ground Up, Second Edition, Springer, 2010.

Objectives

The main purpose of studying this course is to broaden the worldview of a bachelor's degree student in computer engineering by providing a foundation in system-on-chip design and through the in-depth mastery of professional English terminology in the field of FPGA-based hardware design.

Intended learning outcomes - knowledge and understanding

On completion of this course the student will be able to demonstrate: Analyze the functional and nonfunctional performance of the system early in the design process to support design decisions. Analyze hardware/software tradeoffs, algorithms, and architectures to optimize the system based on requirements and implementation constraints. Analyze tradeoffs and explore architecture and mico-architecture design spaces to develop and synthesize custom hardware accelerators. Understand hardware, software, and interface synthesis. Understand issues in interface design. Use co-simulation to validate system functionality. Describe examples of applications and systems developed using a co-design approach. Appreciate issues in system-on-chip design associated with co-design, such as intellectual property, reuse, and verification.

Intended learning outcomes - transferable/key skills and other attributes'

Communication skills: writing professional reports on completed tasks, oral defense of lab work, and expression skills in written examinations. Use of information technology: utilizing software tools for the creation, verification, and simulation of system-on-chip designs, as well as FPGA programming.

Learning and teaching methods

• Lectures, • lab work, • practical assignment.

Assessment	Weight (%)	
Lab work	50	
Practical assignment	50	

Comments

INSTITUTE OF ELECTRONICS AND INFORMATION TECHNOLOGIES

Subject

Microcontroller Systems Programming

Link to the curricula

Study unit code BK4 **2024**

Level	Study program or it's part	Year	Semester
1	COMPUTER ENGINEERING	3	Autumn

ECTS credits	6
Hours - Lectures	**26**
Hours - Laboratory Work	24
Hours - Practical, Seminars	0
Hours - Individual Student's Work	130

Lecturers

Assoc. prof. PhD Oleksii Krasnozhon

Languages - lectures	**English**
Languages - tutorial	**English**

Prerequisites

Practical knowledge of C/C++ and Assembler languages, including writing and debugging programs. Computer logic and computer circuitry, including the ability to read various electrical circuits. Physical basics of electronic equipment to understand the basics of functioning of system devices

Content (Syllabus outline)

The subject of studying are: study of hardware and software development of microcontroller systems.
In the first part of the course, the most common principles of the organization of microprocessor and microcontroller systems are explained. Then the architecture of 8-bit AVR microcontrollers, their command system, and general approaches to programming microcontrollers using Assembler and C languages are studied. The third part of the course deals with the peripheral modules of the microcontroller, such as timers, counters, and the interrupt system.

Textbooks

Elliot Williams Make: AVR Programming. Learning to Write Software for Hardware. 1 edition. Maker Media, Inc, 2014. - Mazidi M.A., Naimi S., Naimi S. The AVR Microcontroller and Embedded Systems: Using Assembly and C. Prentice Hall, 2010. - Joseph Yiu The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors, Third Edition 2014.

Objectives

The purpose of teaching this course is to form a practical and professional worldview of a bachelor in the field of creating a theoretical base, which is necessary for mastering applied questions, clarifying the problems of developing program algorithms and their implementation in C or Assembler languages, students obtaining practical foundations for profiling disciplines.

Intended learning outcomes - knowledge and understanding

On completion of this course the student will be able to demonstrate: basic concepts and definitions of microcontroller technology; the main classes and directions of development of modern microcontrollers; numerical systems used in microcontroller programming; the architecture of universal AVR microcontrollers of Microchip (ATMEL); Basics of operation of peripheral devices and auxiliary integrated circuits; the basic principles of programming modern microcontrollers in the C and Assembler languages; principles of construction of microcontroller systems of applied purpose. Hardware and software debugging tools.

Intended learning outcomes - transferable/key skills and other attributes'

Communication skills: writing technical reports on the performance of various types of work, oral defense of laboratory work, speaking skills in written exams. Use of information technologies: use of software tools for creation, verification and debugging of microcontroller systems, as well as AVR programming.

Learning and teaching methods

• Lectures, • lab work, • practical assignment.

Assessment	Weight (%)	
Lab work	50	
Practical assignment	50	

Comments

INSTITUTE OF ELECTRONICS AND INFORMATION TECHNOLOGIES

Subject

Digital electronics devices

Link to the curricula

Study unit code **XXXXX** **2024**

Level	Study program or it's part	Year	Semester
1	ELECTRONICS OF ROBOTIC SYSTEMS AND COMPLEXES	3	5, 6

ECTS credits	**11**
Hours - Lectures	**48**
Hours - Tutorial	**0**
Hours - Laboratory Work	**42**
Hours - Individual Student's Work	**240**

Lecturers

Senior lecturer, PhD Artem Fesenko

Languages - lectures	**Ukrainian**
Languages - tutorial	**Ukrainian**

Prerequisites

Basic knowledge of discrete math, base logic elements and simple electronic components.

Content (Syllabus outline)

Introduction: Schematic engineering is one of the main areas of knowledge that form a specialist "Telecommunications and radio engineering" specialty. Knowledge obtained during the study of the discipline "Schemotechnics of radio engineering devices" provides an opportunity to understand, design, model, conduct experimental research of devices and systems of telecommunications and radio engineering, carry out their maintenance. In this course, the circuitry of analog, pulse and digital nodes, which can be part of telecommunication and radio engineering devices.

Textbooks

• Op amps for everyone: Design reference/Texas Instruments; Ron Mancine, editor in chief – Advanced Analog Products, 2002. – 464 p. • Rao K.R.K. Analog System Lab Kit PRO: manuals / Rao K.R.K., Ravikumar C.P.: Texas Instruments; editor in chief Zoran Ristic. – MikroElektronika Ltd., 2012. – 102 p.• Ivanets S.A., U.O. Zuban, V.V. Kasimir, V.V. Litvinov. Design of computer system based on FPGA, 2013. – 313 p.

Objectives

The objective of this course is the process of development and modeling of telecommunications and radio engineering systems that contain analog and digital parts implemented on a modern element base.

Intended learning outcomes - knowledge and understanding

On completion of this course the student will be able to demonstrate: • basic knowledge about digital system structure and functional blocks; • knowledge about modern radio and communication digital system design based on FPGA platform; • architecture of modern digital system based on FPGA.

Intended learning outcomes - transferable/key skills and other attributes'

Communication skills: writing of professional report concerning finished exercise, oral lab work defence, manner of expression at written examination. Use of information technology: use of specialized software tools for FPGA-based system design. Calculation skills: execution of basic techniques of timing parameters calculation at lab exercises. Practical skills: implementation and testing FPGA-based digital system on laboratory equipment or in remote lab.

Learning and teaching methods

• Lectures, • lab work, • practical assignment.

Assessment	Weight (%)	
Lab work	40	
Practical assignment	20	
Exam	40	

Comments

INSTITUTE OF ELECTRONICS AND INFORMATION TECHNOLOGIES

Subject

Electrical Circuit Design

Link to the curricula

Study unit code **XXXXX** **2024**

Level	Study program or it's part	Year	Semester
1	TELECOMMUNICATIONS AND RADIO ENGINEERING	3	5

ECTS credits	**12**
Hours - Lectures	**58**
Hours - Tutorial	**0**
Hours - Laboratory Work	**52**
Hours - Individual Student's Work	**280**

Lecturers

Senior lecturer, PhD Artem Fesenko

Languages - lectures	**Ukrainian**
Languages - tutorial	**Ukrainian**

Prerequisites

Basic knowledge of discrete math, base logic elements and simple electronic components.

Content (Syllabus outline)

Introduction: Schematic engineering is one of the main areas of knowledge that form a specialist "Telecommunications and radio engineering" specialty. Knowledge obtained during the study of the discipline "Schemotechnics of radio engineering devices" provides an opportunity to understand, design, model, conduct experimental research of devices and systems of telecommunications and radio engineering, carry out their maintenance. In this course, the circuitry of analog, pulse and digital nodes, which can be part of telecommunication and radio engineering devices.

Textbooks

• Op amps for everyone: Design reference / Texas Instruments; Ron Mancine, editor in chief – Advanced Analog Products, 2002. – 464 p. • Rao K.R.K. Analog System Lab Kit PRO: manuals / Rao K.R.K., Ravikumar C.P.: Texas Instruments; editor in chief Zoran Ristic. – MikroElektronika Ltd., 2012. – 102 p. • Ivanets S.A., U.O. Zuban, V.V. Kasimir, V.V. Litvinov. Design of computer system based on FPGA, 2013. – 313 p.

Objectives

The objective of this course is the process of development and modeling of telecommunications and radio engineering systems that contain analog and digital parts implemented on a modern element base.

Intended learning outcomes - knowledge and understanding

On completion of this course the student will be able to demonstrate: • basic knowledge about digital system structure and functional blocks; • knowledge about modern radio and communication digital system design based on FPGA platform; • architecture of modern digital system based on FPGA.

Intended learning outcomes - transferable/key skills and other attributes'

Communication skills: writing of professional report concerning finished exercise, oral lab work defence, manner of expression at written examination. Use of information technology: use of specialized software tools for FPGA-based system design. Calculation skills: execution of basic techniques of timing parameters calculation at lab exercises. Practical skills: implementation and testing FPGA-based digital system on laboratory equipment or in remote lab.

Learning and teaching methods

• Lectures, • lab work, • practical assignment.

Assessment	Weight (%)	
Lab work	40	
Practical assignment	20	
Exam	40	

Comments

INSTITUTE OF ELECTRONICS AND INFORMATION TECHNOLOGIES

Subject

Digital Systems of Telecommunications

Link to the curricula

Study unit code **XXXXX** **2024**

Level	Study program or it's part	Year	Semester
2	TELECOMMUNICATIONS AND RADIO ENGINEERING	1	1

ECTS credits	**5**
Hours - Lectures	**40**
Hours - Tutorial	**0**
Hours - Laboratory Work	**24**
Hours - Individual Student's Work	**110**

Lecturers

Senior lecturer, PhD Artem Fesenko

Languages - lectures	**Ukrainian**
Languages - tutorial	**Ukrainian**

Prerequisites

Basic knowledge of electronic system, telecommunication systems and interfaces.

Content (Syllabus outline)

Introduction: The purpose of teaching the course "Digital telecommunication systems" is clarify the problems of development of telecommunication systems with the use of modern information technology and telecommunication systems of interaction with information systems.

Textbooks

• Roger L. Freeman/ Telecomunication system engeneering. Wiley-Interscience; 4th edition (June 11, 2004)• P. H. Smale/ Introduction to Telecommunications Systems. Tab Books, 1986, 153 p. • Ivanets S.A., U.O. Zuban, V.V. Kasimir, V.V. Litvinov. Design of computer system based on FPGA, 2013. – 313 p.

Objectives

The objective of this course is the process of development and modeling of telecommunications and radio engineering systems that contain analog and digital parts implemented on a modern element base.

Intended learning outcomes - knowledge and understanding

about the typical telecommunications devices, on the existing principles of telecommunication systems, • about the modern networked devices, • development trends of software tools designed systems, methods of research designed telecommunication systems.

Intended learning outcomes - transferable/key skills and other attributes'

Communication skills: develop block diagrams of telecommunications systems. Use of information technology: programming telecommunication devices, to investigate the functioning of telecommunication devices. Practical skills: know the architectural features of modern network adapters and be able to apply them in the design of telecommunications systems, know the basics of telecommunication technologies; implementation and testing telecommunication devices on laboratory equipment or in remote lab.

Learning and teaching methods

• Lectures, • lab work, • practical assignment.

Assessment	Weight (%)	
Lab work	40	
Practical assignment	20	
Exam	40	

Comments