רשימת קורסים מוצעת במסגרת תוכנית IC Academy

תוכנית IC Academy היא תוכנית להרחבת הידע והיכולות בתחומי החומרה ותכן השבבים באמצעות הקורסים האקדמיים המעולים של הפקולטה בהנדסה באוניברסיטת בר-אילן. תוכנית זו מאפשרת למהנדסים מצטיינים **ללמוד קורס אחד או יותר** משלל הקורסים המתקדמים בתחומי החומרה בבר אילן במסגרת לימודי תעודה.
רשימת הקורסים המוצעים במסגרת התוכנית מפורטת כאן:

Course Name		שם הקורס		
Digital Design Principles (DDP)		עקרונות של תכנון מערכות דיגיטליות		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Digital Logic Design, Front End, Logic Simulation, Verification, Sequential Design, Hackathon	מר יונתן שושן מר אודי קרא פרופ' אדם תימן	Lecture: 2 hours Lab: 2 hours	ב	83607

This course introduces students to the principles of digital logic design using hardware description languages (HDL). In the course, the basics of hardware design are introduced from a logic designer's perspective using synchronous logic and state machines and leads the students into the realm of system design using these approaches. The course will also introduce concepts of design verification. The course is composed of a two-hour weekly lecture accompanied by a two-hour lab session, during which the students will practice the concepts by designing and verifying logic blocks with System Verilog. During the second half of the course, the students will be introduced to a full system-on-chip platform, integrate their own blocks into the platform, and finally, present their designs to a panel of judges following an industry-sponsored hackathon.

Course Name		שם הקורס		
Digital Circuits Lab		מעבדה למעגלים אלקטרוניים ספרתיים		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Digital Circuit Design, Transistor Simulation, SPICE, Layout, Lab	פרופ' אלכס פיש	Lab: 3 hours	א	83315

This course provides the participants with hands on experience in the schematic design, circuit simulation, layout, and post-layout simulation of digital circuits. This practical course is made up of three hour lab sessions using industry standard circuit design tools (Cadence Virtuoso) and actual industrial process technologies to implement digital circuit design, analysis and validation from the single transistor level to complex gate design. The course requires basic knowledge of digital circuit and digital systems theory, as well as basic background in electronics and semiconductor devices.

Course Name		שם הקורס		
Digital Integrated Circuits and VLSI		מעגלים משולבים ספרתיים		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
VLSI, Digital Circuit Design, Moore's Law, Transistors	פרופ' אדם תימן	Lecture: 3 hours Lab: 1 hour	ב	83313

This course introduces VLSI technology, from the basics of the manufacturing process through the effects of scaling on circuit design due to five-plus decades of Moore's law and through to the circuit design, analysis and implementation of digital components, such as arithmetic circuits, flip-flops and embedded memories. The course includes a three hour lecture, delivered according to the "flipped classroom" approach, accompanied by an hour of hands on labs to assist with the assignments. These assignments cover design and analysis, including the principles of mixed-signal simulation, and are implemented using industry standard design tools (Cadence Virtuoso, Mentor Calibre, Cadence Liberate) and industrial process technologies. The course requires basic knowledge of digital circuit and digital systems theory, as well as a background in electronics and semiconductor devices. While not required, previous experience using circuit design tools (e.g., Virtuoso, course 83315) is preferable.

Course Name		שם הקורס		
Digital VLSI Design (DVD) - From RTL to GDS		מעגלי ומערכות VLSI דיגיטליים		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Backend, RTL2GDS, Synthesis, Place & Route, Chip Design	פרופ' אדם תימן	Lecture: 3 hours Lab: 1 hour	א	83612

This unique course, provides the participants with a full theoretical and practical overview of the implementation of an integrated circuit (chip), from logic design (RTL) to final layout (GDS), going through logic synthesis, floorplanning, place and route, static timing analysis and signoff requirements. The course is made up of three hour lectures, delivered according to the "flipped classroom" approach, accompanied by an hour of hands on labs to assist with the assignments. The assignments are carried out upon industry standard tools (Cadence Xcelium, Innovus, Tempus, Voltus) using industrial process technologies and IP libraries. The course requires basic knowledge of digital circuit and digital systems theory, as well as a background in electronics and semiconductor devices.

Course Name		שם הקורס		
Analog Circuits Lab		מעבדה למעגלים אנלוגיים		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Analog Circuit Design, Simulation, Lab Course	פרופ' יוסי שור	Lab: 3 hours	ב	83325

This lab course enables practical experience in the design of circuits which were studied in theory in an introductory Linear Circuits course. The circuits are designed and simulated in the Cadence environment and the student is expected to show good functionality of the circuits. These circuits include the basic building blocks of analog design, including single state amplifiers, such as common source and source follower, cascodes, the single stage amplifier. It also includes analysis of the two stage amplifiers, such as the Miller Amplifier. This includes implementation of the feedback compensation. The lab concludes with two measurement assignments.

Course Name		שם הקורס		
Analog Integrated Circuits		מעגלים משולבים אנלוגיים		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Analog Circuit Design, Feedback, Noise, Bandgap, Comparator	פרופ' יוסי שור	Lecture: 2 hours Practice: 1 hour	ב	83325

This course is a follow-up to an introductory Linear Circuits course, as well as the Analog Circuits Lab (course 83-325). This introduces the students to more complex analog circuits and gives some experience in design and simulations as well. The curriculum includes stability and compensation of analog feedback circuits, analysis of circuit offsets as well as offset cancellation methods. Circuit noise theory is analyzed and techniques to reduce and eliminate noise are discussed. Several circuit topologies are discussed, including bandgap references, comparators and folded cascode amplifiers. The course includes several design assignments and well as a personal project.

Course Name		שם הקורס		
Low power VLSI Design		תכנון מעגלי VLSI בהספק נמוך		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
VLSI, Low Power Design	פרופ' אלכס פיש	Lecture: 2 hours	ב	83946

This course discusses circuit and system design for low-power ASICs. In this course, we will cover low power design techniques and methodologies, starting with the circuit-level through the component design and up to system-level techniques for reducing power consumption in nanoscaled processes.

Course Name		שם הקורס		
Advanced Digital VLSI Circuits and Systems Design 1		תכנון מתקדם של מעגלי ומערכות VLSI 1		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Microprocessor, Microcontroller, RISC-V, Embedded Systems	פרופ' אדם תימן	Lecture: 3 hours	ב	83953

In this course, we will revisit the entire computing stack from a circuit designer's perspective, looking upward to familiarize the students with the higher levels of abstraction. The course covers aspects, such as microcontrollers, CPUs, ISAs, Operating Systems and memories. Students will develop code blocks and accelerators upon an open source, RISC-V platform. This course is composed of three-hour weekly lectures.

*Note that this course is **not** a prerequisite for ADVLSI2 (83954).*

Note that this course is only given once every two years – Next iteration: Spring 2023.

Course Name		שם הקורס		
Advanced Digital VLSI Circuits and Systems Design 2		תכנון מתקדם של מעגלי ומערכות VLSI 2		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Nanoscaled processes, Hardware for AI, Advanced circuits & systems	פרופ' אדם תימן	Lecture: 3 hours Lab: 1 hour	א	83954

In this course, we will cover advanced and emerging concepts in digital VLSI, adapted for current state-of-the-art research and hot topics. The course includes subjects, such as advanced process nodes, simulation methods, low power physical design, design for test, custom design of digital blocks and hardware design for domain-specific applications. This course is composed of three-hour weekly lectures. *Note that this course is only given once every two years.*

*Note that this course **does not require** ADVLSI1 (83953) as a prerequisite.*

Note that this course is only given once every two years – Next iteration: Spring 2022.

Course Name		שם הקורס		
Theory of digital systems		תיאוריה של מערכות ספרתיות		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Boolean logic, combinatorics, fault checking	פרופ' אסנת קרן	Lecture: 2 hours Practice: 2 hours	א	83256

This course complements the elementary course on digital switching circuits. It is well known that AND, OR and NOT operations form a universal set. But, why is it? Are there better sets? How to use them? Are combinational designs fault secure? Are they self testing? Is it possible to design an on-line checker for detecting faults in combinational circuits that at the same time can check itself? These questions and more will be addressed in this course.

Course Name		שם הקורס		
Microelectronic Manufacturing Processes		תהליכי ייצור במיקרואלקטרוניקה		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
VLSI, Fabrication Process, Integrated Circuits, Lithography	דר' יואב ויצמן	Lecture: 3 hours Practice: 1 hour	ב	83311

This is an introductory level course, which presents elementary processes in various steps of microelectronics manufacturing process. The course focus on the fabrication steps of integrated circuits in CMOS technology. We will make an acquaintance with the basic manufacturing processes used in the industry for manufacturing and explain the impact on electrical properties of the manufactured device. We will focus on the lithographic process, which used to be the historic bottleneck in the advent of scaling. The course will present the various steps while providing the student the ability to find his way in the constant development and progress of technology.

Course Name		שם הקורס		
Reliability of VLSI Components		אמינות של רכיבי VLSI		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Testing, Design for Test, ATPG, Validation, Fault Modeling	דר' יואב ויצמן	Lecture: 2 hours	א	83950

This course will focus on postproduction validation process of integrated circuits. The major part of the course will be dedicated to testing theory and practice of logic circuits using ATE including; Fault Modeling, fault simulations, automated test pattern generation, design for testability and build in self testing. We will also cover failure analysis processes and root cause analysis and high-speed interfaces characterization.

Course Name		שם הקורס		
Reliability of Hardware Systems		אמינות של מערכות חומרה		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Reliability, Nanoscaled Devices, Aging, Failure Analysis	דר' יואב ויצמן	Lecture: 3 hours	א	83606

This course will focus on the physical processes taking place in nano-scale electronics devices, which might degrade the device performance over time. Modern integrated circuits are sensitive to failure processes that can be random or malicious. These failures will have critical effect on device performance and eventually might lead to catastrophic failures in critical apparatus (like autonomic vehicle of pacemaker) during the lifetime of electronic components gradual aging processes occurs, these processes can be anticipated, monitored and controlled with target failure distributions to allow safe operation. The course will present the major aging processes form physical perspective and provide the tools to evaluate the failure probabilities.

Course Name		שם הקורס		
Formal Verification and Synthesis		אימות פורמלי וסינתזה		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Formal verification, synthesis, modeling	פרופ' הלל קוגלר	Lecture: 2 hours Practice: 1 hour	א	83691

This course will cover the basic principles underlying formal verification methods, how properties of the system can be formally specified and the design of algorithms to efficiently verify or refute such properties. The course will also include hands on experience in applying verification methods to software and hardware systems. We will also cover synthesis, whose main goal is to automatically synthesize a correct by construction program that is guaranteed to satisfy the requirements. We will study some of the recent application of synthesis methods in software engineering and in modelling biological systems. The course is made up approximately 13 lectures and 13 practice sessions in which students will gain practical experiences with the theory and tools. A basic understanding of algorithms and basic automata theory is assumed in the course.

Course Name		שם הקורס		
Embedded Systems Lab		מעבדה במערכות משובצות		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Embedded Systems, Lab course	דר' לאוניד יביץ	Lab: 3 hours	א	83317

This lab course provides the participants with hands on experience in the design and operation of embedded systems. The participants will get acquainted with the microcontroller and program its peripherals, such as timers and interrupt controllers. In addition, the participants will practice communicating through serial and parallel ports, operate DAC and ADC blocks, and write high-level programs that run on real-time operating systems.

Course Name		שם הקורס		
Computer Arithmetics		אריתמטיקה למחשב		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Algorithms, Arithmetic Logic Unit (ALU), FPU, number systems	פרופ' אסנת קרן	Lecture: 2 hours Practice: 1 hour	ב	83653

This course concentrates on fundamental principles of algorithms for performing arithmetic operations in digital computers, design and hardware implementation of basic elements of Arithmetic Logic Unit (ALU) and Floating Point Unit (FPU). We will see how by using unconventional number systems we can obtain high-speed low-cost addition, multiplication and division, as well as efficient implementations of other elementary functions.

Course Name		שם הקורס		
Operating Systems		מערכות הפעלה		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Operating Systems, Processes and Threads, Scheduling	מר חיים שפיר	Lecture: 2 hours Practice: 2 hours	א	83381

This course examines the important problems in operating system design and implementation. The course will start with a brief historical perspective of the evolution of operating systems over the last fifty years and then cover the major components of most operating systems. This discussion will cover the tradeoffs that can be made between performance and functionality during the design and implementation of an operating system. Particular emphasis will be given to three major OS subsystems: process management (processes, threads, CPU scheduling, synchronization, and deadlock), memory management (segmentation, paging, swapping), and file systems; and on operating system support for distributed systems.

Course Name		שם הקורס		
Computer Architecture		מבנה מחשבים ספרתיים		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Computer Architecture, Amdahl's Law, Memory Hierarchy, Cache	דר' לאוניד יביץ	Lecture: 3 hours Practice: 1 hour	ב	83301

This course covers the basic principles of modern computer architecture, including performance metrics, memory hierarchy, main memory, memory consistency and coherency, multicore, cache memory organization, branch prediction, instruction level parallelism, superscalar, out of order execution, multithreading, virtual memory and GPU. We will also get acquainted with different memory architectures: static, dynamic and associative memory (for fully associative cache).

Course Name		שם הקורס		
Advanced Computer Architecture		ארכיטקטורת מחשבים מתקדמת		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Architecture, domain-specific accelerators, emerging memories	דר' לאוניד יביץ	טרם נקבע	טרם נקבע	טרם נקבע

This course will cover advanced topics in computer architecture, including Amdahl's Law and the end of Moore and Dennard scaling, memory systems and organization (DRAM, HBM, CAM/TCAM), emerging memory (STT-MRAM, PCM, ReRAM), secure memory (ORAM), array, vector and systolic processors, near-memory and in-memory processing, associative processing, sparse data formats and processing, analytical modeling of computer architecture and selected topics in domain specific accelerators: Accelerators for deep learning, accelerators for genome analysis.

Note: This course will be available during the 2022-23 academic year.

Course Name		שם הקורס		
Introduction to Secure Hardware		מבוא לחומרה בטוחה		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Hardware Security, Cryptography, AE Algorithms	דר' איתמר לוי	Lecture: 3 hours Practice: 1 hour	א	83673

At its beginning, this special course is dedicated and aimed at exposing students from all levels (whether they have crypto background or not), to notions of information security. Although it is not a pure crypto course nor a cryptanalysis course its goal is to set a nice common ground to deal with aspects which tightly relate to these topics. Therefore, we touch upon multiple necessary topics from these fields right at the start of the course. From necessary crypto basics, primitives and constructions, exemplified with efficient block ciphers and cryptographic-hash functions and authenticated-encryption (AE) algorithms, we dive in and teach students what is and how cryptanalysis works while discussing security criteria of primitives and smaller building-blocks. The course follows with discussing conceptual weaknesses of implementations, introducing leakage (physical attacks) as a concept and elaborates on how it is possible to break the adversary model. It follows with discussing physical information assisted attacks which completely undermine our way of design and changes the cost of what we define as secure. It exposes students to countermeasures on multiple abstraction layers with a special emphasis on efficiency and cost on all computational platforms (from hardware to software). Finally, in the course we expose students to security evaluation metrics and elaborate on primitives like low-cost randomness generation, device fingerprinting mechanisms, etc.

Course Name		שם הקורס		
Introduction to Secure Hardware (Expanded)		מבוא לחומרה בטוחה מורחב		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Hardware Security, Defenses, Countermeasures, Attacks	דר' איתמר לוי	Lecture: 3 hours Practice: 1 hour	ב	83682

Like 83673, this course provides some background on the field of hardware security (and information security in general), however, it is aimed at enabling a more in-depth introduction. It is tailored to students who have background knowledge in discrete mathematics, arithmetic fields, complexity and basic cryptography. In this course, less effort is given to educate on background material while enabling the students to absorb more advanced information, more specific and dedicated attacks relating to deep hardware-security challenges, more in-depth education relating to countermeasures and defenses, statistically-assisted attacks, etc.

Course Name		שם הקורס		
Advanced subjects in Hardware Security		נושאים מתקדמים באבטחת חומרה		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Hardware Security, Physical Attacks, SCA, PQC, ML/AI	דר' איתמר לוי	Lecture: 2 hours	ב	83683

This unique course exposes students to cryptographic challenges in light of physical implementation constraints. We teach in-depth several promising light weight crypto candidates to replace the current standards in the years to come. We develop and discuss attacks and advanced physical attacks which extract information from the hardware or software implementation of the algorithm on devices. We discuss in-depth implementation aspects, their need from implementations and specifications. The goal is to expose students to standard asymmetric crypto primitives and to standard and advanced attacks, motivating the need for side-channel attacks (SCAs) security for those and for post-quantum (PQC) algorithms. We discuss several PQC asymmetric crypto primitives, advanced attacks, limitations and challenges. The course also discusses in details multiplication algorithms and tradeoffs which are at the heart of most of the discussed primitives. Once every two years we also introduce learning-algorithms (ML/AI) for SCA security evaluation and attacks and open challenges.

Course Name		שם הקורס		
Designing secure circuits		שיטות תכנון מעגלים בטוחים		
מילות מפתח	שם המרצה	שעות שבועיות	סמסטר	מספר הקורס
Hardware Security, Random Number Generators, PUFs	דר' יואב ויצמן	Lecture: 2 hours Practice: 1 hour	ב	83452

This course will present various techniques for hardware implementation with emphasis on designing special circuits compatible with secured hardware. We will present the vulnerabilities of hardware systems and the methods to apply protection, while classifying the different methods. The course will present techniques to protect IP by passive and active methods and metrics to evaluate the probabilities for counterfeit detection. Specifically, we will focus on the following primitives: random numbers generators and physical unclonable functions. We will present advanced protection techniques against side channels attacks. Finally, we will present the threat of Trojan horses and means to detect and protect against this threat.