وصف المختبرات 2025-2024

جامعة نينوى

كلية هندسة الالكترونيات

قسم هندسة الالكترونيك

Ninevah University
College of Electronics Engineering
Electronic Engineering Dept.

مختبر الحاسوبI

Computer Laboratory I

1st Class(2024_2025)

Laboratory Supervisor: Asmaa Nabeel Khaleel

Laboratory Assistant : Hajar Khalil Ibrahim

Noor alhuda Saad

Introduction:

The computer Laboratory is a fundamental part of studying computer science in engineering. It aims to Provides students or users with access to computers and software they may not have at home and Ensures equal opportunity for learning and productivity, Encourages group work, peer-to-peer learning, and collaboration on projects, Equipped with specialized software for programming, design, data analysis, simulations and Centralized updates and maintenance ensure all users have access to the latest tools. Also, Allows instructors to guide, monitor, and assist students easily during lessons and Helps maintain discipline and focus. Computer Lab is More affordable than providing individual computers to every student then Easier to maintain and manage as a networked system. Finally, Suitable for conducting online tests, coding assessments, or computer-based exams securely.

Laboratory Objectives:

1) Enhance Digital Literacy
   - Help students or users become familiar with computers and essential software.
   - Teach skills like typing, file management, internet use, and basic troubleshooting.

2) Support Academic Learning
   - Provide tools for researching, writing, coding, designing, and data analysis.
   - Enable use of educational software related to various subjects.

3) Hands-on Practical Experience
   - Allow students to apply theoretical knowledge in real-life computer environments.
   - Support courses in programming, networking, graphic design, etc.

4) Encourage Collaboration and Teamwork

• Promote group projects, shared learning, and peer support.

5) Prepare for the Workforce

• Train users in industry-relevant tools and applications (e.g., MS Office, coding platforms, design software).

• Build skills that are valuable in modern jobs.

6) Provide Equal Access

• Ensure all students, regardless of background, have access to computers and the internet.

7) Promote Safe and Responsible Use of Technology.

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مختبر دوائر التيار المستمر

DC Circuit Analysis Laboratory

1st Class (2024_2025)

Laboratory Supervisor: Zahraa Siddiq Yahya

Laboratory Assistant: Maysara Abduljabar

Sidra Abduljabar

Saif Kamal

Asaad Abdulgani

Yosuf Mahir

Introduction:

The DC circuit analysis Laboratory is a fundamental part of studying DC circuit analysis in engineering. It aims to equip students with the knowledge and skills necessary to analyze and process DC circuit using advanced techniques. In this laboratory, many tools are used for conducting practical experiments that enhance students' understanding of the theoretical part. This lab focuses on applying experiments that help students engage with DC circuit in a practical way.

Laboratory Objectives:

1. **This is a basic lab:** Introduce this lab for the students as a basic lab for all electrical and electronic circuits in the lab for the remaining stages.
2. **Understand the basic concept of DC electrical circuits**: Enable students to deal with basic components and devices used in electrical circuits in the lab.
3. **Develop Basic Skills using lab tools:** Teach students how to use lab tools to understanding the application of DC circuit analysis theory through the experiments, enabling them to handle various measurements related to DC circuit analysis.
4. **Teach Students how to connect DC circuits:** Enable students to connect different circuits by using all the components and tools available in the lab.
5. **Obtaining the results:** after connect the DC circuits, Teach the students how to they getting the results from the reading of the devices used in the lab.
6. **Apply Acquired Skills in DC circuits Analysis**: Enable students to apply what they have learned in the lab to implementation any application of the theorems of DC circuit analysis.

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مختبر المنطق

Logic Laboratory

1st Class(2024_2025)

Laboratory Supervisor: Maysara Abduljabbar Qasim

Laboratory Assistant : Hajar Khalil Ibrahim

Noor alhuda Saad

Asmaa Nabeel Khaleel

Introduction:

The Logic Laboratory is a fundamental part of studying computer science in engineering, The Digital Logic Lab is one of the core labs for first-year students in the Computer Engineering Department. Students apply the practical aspects of the Digital Systems and Logic Circuits course.

The main objective of this lab is to provide an introduction to digital logic and the basics of logic circuit design with an emphasis on the use of practical implementation techniques for these circuits..

The lab topics include the following:

1. Helping the student understand the operation of basic logic gates, Boolean algebra theories, and methods for simplifying logical functions through theoretical analysis.
2. Designing combinational and interactive digital circuits, such as digital comparator circuits, binary encoder and decoder circuits, and logical addition and subtraction circuits using discrete circuits such as half-adders and full-adders.
3. Introducing the student to circuit design using schematic capture, how they work, and how to perform logical simulations of these circuits.

Laboratory Objectives:

1) Teaching Basic Concepts: Teach students the basic principles of digital logic, such as Boolean algebra, logic gates, and truth tables

2) Developing Practical Skills: Train students to design and implement digital circuits using appropriate tools and components.

3) Understanding Digital Systems Design: Teach students how to design complex digital systems such as microprocessors and memory.

4) Analysis and Debugging: Develop students' skills in analyzing and debugging digital circuits.

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مختبر دوائر التيار المتناوب

AC Circuit Analysis Laboratory

1st Class (2024_2025)

Laboratory Supervisor: Zahraa Siddiq Yahya

Laboratory Assistant: Sidra Abduljabar

Asaad Abdulgani

Yosuf Mahir

Introduction:

The AC circuit analysis Laboratory is a fundamental part of studying AC circuit analysis in engineering. It aims to equip students with the knowledge and skills necessary to analyze and process AC circuit using advanced techniques. In this laboratory, many tools are used for conducting practical experiments that enhance students' understanding of the theoretical part. This lab focuses on applying experiments that help students engage with AC circuit in a practical way.

Laboratory Objectives:

1. **This is a basic lab:** Introduce this lab for the students as a basic lab for all electrical and electronic circuits in the lab for the remaining stages.
2. **Understand the basic concept of AC electrical circuits**: This course deals with the basic concept of AC circuits by understand waveform and frequency and the basic concept of RL and RC circuits in the lab.
3. **Develop Basic Skills using lab tools:** Teach students how to use lab tools to understanding the application of AC circuit analysis theory through the experiments such as oscilloscope, enabling them to handle various measurements related to AC circuit analysis.
4. **Teach Students how to connect AC circuits:** Enable students to connect different circuits by using all the components and tools available in the lab.
5. **Obtaining the results:** after connect the AC circuits, Teach the students how to getting the results from the readings of the devices used in the lab.
6. **Apply Acquired Skills in AC circuits Analysis**: Enable students to apply what they have learned in the lab to implementation any application of the theorems of AC circuit analysis.

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مختبر الإشارة والنظم I

Signals and Systems Laboratory I

2nd Class (2024_2025)

Laboratory Supervisor: Rasha Waleed Hamad

Laboratory Assistant : Hajar Khalil Ibrahim

Yathrib Waleed Qasim

Introduction:

The Signal and Systems Laboratory is a fundamental part of studying signals and systems in engineering. It aims to equip students with the knowledge and skills necessary to analyze and process signals using advanced mathematical techniques. In this laboratory, MATLAB is used as the primary tool for conducting practical experiments that enhance students' understanding of the mathematical and signal-processing foundations of systems. This lab focuses on applying programming techniques using MATLAB to analyze and process various signals through a series of methodical scientific experiments that help students engage with signals and systems in a practical way.

Laboratory Objectives:

1. **Introduction to MATLAB**: An introduction to the MATLAB environment, including learning how to use basic tools to execute initial programming commands.
2. **Introduction to MATLAB**: A continuation of the introduction to MATLAB, focusing on building a solid understanding of the basics of programming in MATLAB
3. **Matrix Functions**: Learning how to work with matrices in MATLAB and use the related functions to perform
   mathematical operations.
4. **Mathematical Operations using MATLAB**: Applying advanced mathematical operations on signals and systems using MATLAB, including operations like differentiation and integration.

5. **Overview of MATLAB Plotting**: An introduction to MATLAB's plotting tools, such as creating graphical plots to visualize and analyze signals and systems.
6. **Generating Waves (Signals)**: Learning how to generate different signals (such as sine waves) using MATLAB and analyzing the properties of these signals.

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مختبر برمجة C++

C++ programming Laboratory

2nd Class(2024_2025)

Laboratory Supervisor: Dr. Qais Thanon Algwari

Laboratory Assistant : Saif Al-deen Kamal

Introduction:

This laboratory course is designed to complement classroom learning by giving practical, hands-on experience with C++. Here, the students will apply the concepts learned in lectures and gain confidence in writing, compiling, and debugging C++ programs. In this lab, the students will start with the basics like input/output operations, control structures, and functions, and gradually work way toward more advanced topics such as arrays, pointers, and file handling. The lab sessions will challenge students to think critically, solve problems efficiently, and write clean, well-structured code.

Laboratory – Objectives :

The primary objective of the C++ Programming Laboratory is to provide students with practical exposure to the fundamental and advanced concepts of C++ programming. By the end of the lab course, students will be able to:

1. **Understand Basic Programming Constructs:**
   - Implement programs using basic C++ syntax, data types, variables, operators, and expressions.
   - Apply control structures such as conditional statements and loops to solve problems.
2. **Develop Modular Programs:**
   - Create reusable and organized code using functions with appropriate parameter passing and return mechanisms.
3. **Work with Arrays and Strings:**
   - Implement and manipulate one-dimensional and multi-dimensional arrays.
   - Perform operations on strings using built-in and user-defined methods.
4. **Understand Pointers and Dynamic Memory Management:**
   - Use pointers for accessing and manipulating memory.
   - Implement dynamic memory allocation and deallocation.
5. **Work with Files:**
   - Read from and write to text and binary files using C++ file I/O streams.
6. **Debug and Analyze Code:**
   - Use debugging tools and techniques to identify and correct logical, syntax,

and runtime errors.

7. **Develop Logical Thinking and Problem-Solving Skills:**
   - Approach problems methodically and apply algorithmic thinking to implement solutions in C++.
8. **Gain Exposure to Real-World Applications:**
   - Develop mini-projects or problem statements that simulate real-world scenarios to reinforce learning.

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مختبر الالكترونيك I

Electronic Labatory I

2nd Class (2024-2025)

Laboratory Supervisor: Omar Najeeb

Laboratory Assistant : Shawket Mohammed

Yousif Maher

Assad Abdoul Ganee

Introduction

The Electronics Laboratory is an essential component of the academic curriculum for electrical and electronics engineering students. It aims to enhance the practical understanding of theoretical concepts related to semiconductors and transistors. The laboratory provides an interactive learning environment where students can analyze and design electronic circuits, helping them develop the necessary skills to apply academic knowledge in real-world projects an industrial applications.

Laboratory Objectives

1. Understanding the Characteristics and Functionality of Semiconductors.
2. Analyzing and Designing Electronic Circuits.
3. Learning Biasing Techniques and Frequency Response.
4. Practical Applications of Electronic Circuits.
5. Developing Practical Skills in Measurement and Troubleshooting

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مختبر المكائن الكهربائية

Electrical machine Laboratory

2nd Class (2024_2025)

Laboratory Supervisor: Maysara Abduljabbar Qasim

Laboratory Assistant : Hisham Mohamed Abbas

Sidra Abduljabbar Youssef

Introduction:

The electrical machine Laboratory is a fundamental part of studying various machines in engineering. It aims to equip students with the knowledge and skills necessary to principle operating and using advanced machine techniques. The laboratory specializes in DC machine applications inside the laboratory, and covers experiments related to the electrical machines subject for the second stage and learning about the characteristics of DC motors in series and parallel, in addition to electrical transformers. These experiments are carried out on ready-made boards equipped with the required measuring devices. MATLAB is used as the secondary tool for conducting practical experiments that enhance students' understanding of the mathematical modeling and simulation of machines.

Laboratory Objectives:

1. Introducing the student to electrical machines, their composition, the basis of their operation, and how to convert mechanical energy into electrical energy and vice versa using a magnetic field
2. Preparing the student to study the various calculations for alternating current and direct current electrical machines and to become familiar with the various theories for these calculations.
3. Introduction to calculating DC, external voltage, torque, speed, current, power, power factor, and values of the main components of the motor such as resistors and inductors..
4. Tests on different types of electrical machines to obtain the machine's magnetic properties, load and power properties, and electric field properties.
5. Training students on laboratory work methods, how to prepare reports, and how to use equipment.
6. Teaching students to use computer programs such as **MATLAB** to create virtual simulations of electrical machines and to represent mathematical models that simulate electric and magnetic field equations.

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مختبر الإشارة والنظم II

Signals and Systems Laboratory II

2nd Class (2024_2025)

Laboratory Supervisor: Rasha Waleed Hamad

Laboratory Assistant : Hajar Khalil Ibrahim

Yathrib Waleed Qasim

Introduction:

The Signals and Systems Lab is an essential part of the study of signals and system analysis in engineering. In this lab, students learn how to analyze and process signals using advanced mathematical techniques and tools. The lab focuses on the practical applications of MATLAB in the study and analysis of signals and systems. This lab emphasizes hands-on experiments where students explore complex mathematical and signal-processing concepts using MATLAB and advanced simulation tools like Simulink. The main goal is to train students on how to design and analyze systems using computational software that provides effective solutions to engineering problems.

Laboratory Objectives:

1. **Deepen theoretical and practical understanding of signals and systems:** Enable students to understand various types of signals and systems, and apply mathematical theories to solve signal-related problems.
2. **Develop practical programming skills using MATLAB:** Enhance students' ability to use MATLAB to analyze and design signal systems, including complex mathematical operations like convolution and Fourier transforms.
3. **Teach advanced signal analysis techniques:** Enable students to use techniques like Fourier series and Fourier transforms to analyze periodic and continuous signals, and understand the relationship between the time domain and frequency domain.
4. **Hands-on simulation applications:** Strengthen students' ability to use simulation tools like MATLAB and Simulink to simulate system behavior and analyze its response under different conditions.
5. **Teach how to use simulation tools in system analysis:** Allow students to design systems using Simulink and analyze system behavior with interactive simulation tools.

6. **Stimulate critical and analytical thinking:** Encourage students to apply analytical thinking when dealing with complex signal problems and enhance their ability to solve these problems creatively using MATLAB and Simulink.

7. **Prepare students for real-world engineering applications:** Equip students with the necessary knowledge and skills to apply what they've learned in real-world engineering fields such as signal processing, control systems, communications, and other areas that depend on signal and system analysis.

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مختبر الالكترونيك التناظري 2

Analge ElectronicLaboratory II

2nd Class(2024_2025)

Laboratory Supervisor: Omar Najeeb

Laboratory Assistant : Shawket Mohammed

Yousif Maher

Assad Abdoul Ganee

Introduction

The Electronics Laboratory is an essential component of the academic curriculum for electrical and electronics engineering students. It aims to enhance the practical understanding of theoretical concepts related to semiconductors and transistors. The laboratory provides an interactive learning environment where students can analyze and design electronic circuits, helping them develop the necessary skills to apply academic knowledge in real-world projects an industrial applications.

Laboratory Objectives:

1. Understand and apply the basic theory and operation of FET transistor amplifiers (JFET and MOSFET)
2. Define and explain the frequency response of FET amplifiers.
3. Understand and analyze the feedback amplifier
4. Understanding the operation of ideal operational amplifier.
5. Dealing with dc and ac op-amp equivalent circuit.

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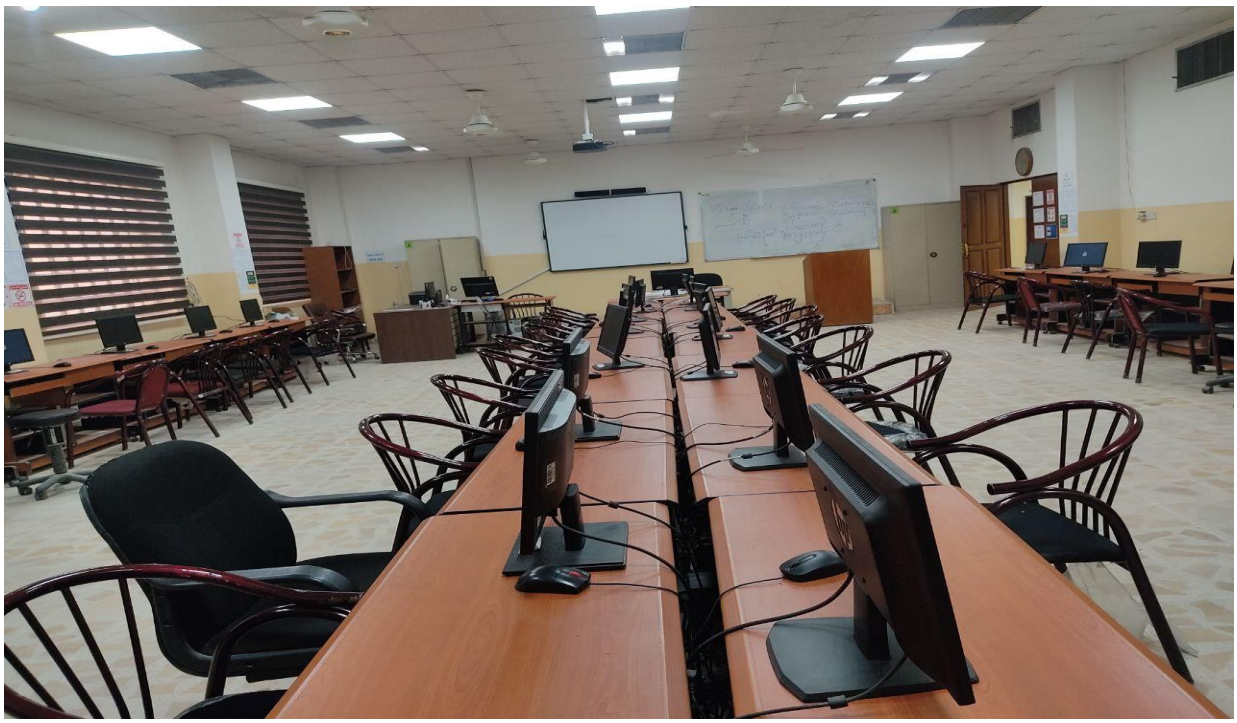
مختبرالحاسوبII

Computer LAB.II

2nd Class(2024_2025)



Laboratory Supervisor: Khalid F.Mahmmod

Laboratory Assistant :Younis S. Othman

Hani M.S. Salman

Introduction:

The Computer Lab is a fundamental component of the study of electronic systems in engineering. It aims to provide students with the knowledge and skills necessary to analyze and process data using advanced computer technologies. In this lab, Touch Able and Packet Tracer are used as essential tools for conducting practical experiments that enhance students' understanding of the programming foundations of network systems and their security. This lab focuses on applying artificial intelligence programming techniques to analyze and process images, sound, and motion through a series of systematic scientific experiments that help students interact with intelligent systems in a practical way.

Laboratory Objectives:

1. Developing basic programming skills using Packet Tracer: Teaching students how to use Touch Able and Packet Tracer as an effective tool for simulation, implementation, and analysis, enabling them to handle various network-related programming tasks.

2. Understanding networking fundamentals and AI security: Enabling students to understand basic processes such as network components and the flowchart solution environment.

3. Introducing students to information creation and confidentiality: Teaching students how to use information security.

4. Teaching students how to build, analyze, and secure network systems: Enabling students to analyze computer networks and how to handle data-related threats.

5. Equipping students with intelligent systems skills: Teaching students how to use intelligent systems software and harness it to serve their studies and generate creative skills in their field of work.

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مختبر الفسلجة البشرية

HUMAN PHSIOLOGY I

2nd Class (2024_2025)

Laboratory Supervisor: Baraa yaqoob yousif

Laboratory Assistant : Omamah Qasim Fathi

Sameer Mahmood Yaseen

Introduction:

The Animal Physiology Laboratory is an educational and research environment that contributes to the study of the functions of organs and biological systems in living organisms. The laboratory aims to understand how organisms interact with their environment and how biological systems perform their various functions, thereby helping to clarify many biologic alphenomena. Studies in the Animal Physiology Laboratory encompass a diverse range of topics, such as respiration processes, circulation, digestion processes, metabolism, and water balance. Various techniques are employed, including laboratory experiments, clinical observation, and the use of advanced devices for data analysis. The laboratory also contributes to training students and researchers on the practical and theoretical skills needed in this field, equipping them to conduct future research and work in various areas such as biology, veterinary medicine, and public health sciences. The Animal Physiology Laboratory represents a starting point for understanding ecological systems and their relationships with modern scientific developments, opening new horizons in research and health applications.

Laboratory Objectives:

1. Understand Physiological Processes:

Gain a comprehensive understanding of the major physiological systems in animals, including circulatory, respiratory, nervous, muscular, excretory, and digestive systems.

2. Develop Practical Skills:

Learn to use laboratory equipment and techniques to measure physiological parameters such as heart rate, respiration rate, blood pressure, muscle contraction, and nerve responses.

3. Perform Experimental Analysis:

Conduct experiments to observe and analyze physiological responses under various conditions and treatments.

4. **Interpret Data Scientifically:**

Record, analyze, and interpret experimental data using appropriate scientific methods and reasoning.

5. **Correlate Theory with Practice:**

Apply theoretical knowledge from lectures to real-life biological systems and experimental outcomes.

6. **Enhance Critical Thinking:**

Develop analytical and problem-solving skills by designing experiments, forming hypotheses, and drawing conclusions from results.

7. **Promote Ethical Handling of Animals:**

Understand and apply ethical standards and humane practices when working with live animals or biological specimens.

8. **Encourage Teamwork and Communication:**

Foster collaborative work and improve scientific communication skills through group experiments, discussions, and lab reports.

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Lab 4: Bleeding time (Ducks method, ivy's method).

Lab 5: Clotting time (capillary tube. Method; lid method).

Lab 6: Packed cell volume (P.C.V).

Lab 7: Red blood cells count

Lab 8: Blood smear; staining

Lab 9: Differential leukocyte count (types of W.B.C.).

Lab 10: ABO blood types; slide method; true method.

Lab 11: Examination of the urine; urine collection.

Ninevah University
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مختبر الإلكترونيك والاتصالات

Electronic and communication Laboratory

3th Class (2024_2025)

Laboratory Supervisor: Dr .Ahmed Salama

Laboratory Assistant : Dr .Omar Badar

Hisham Mohammed

Asmaa Nabil

Hajar Khalil Ibrahim

Noor alhuda Saad,

Najm Obeid

Introduction:

The Electronic and Communication Laboratory is a fundamental part of studying Electronic and Electronic in Electronic collage engineering. It aims to equip students with the knowledge and skills necessary to analyze and Circuits and electronics application using advanced electronics techniques. In This lab we covers detailed experiments on electronic communications systems, detailing the functions of transmitters and receivers. It also explains signal types, particularly digital signals, and discusses the modulation and multiplexing techniques necessary for efficient information transmission.

Laboratory Objectives:

1- Understand the usage of equipment/components used to conduct the experiments in analog and digital modulation techniques.
2- Conduct the experiments in Modulation and Demodulation schemes to find the important metrics of the communication system experimentally.
3- Analyze the performance of a given Modulation and Demodulation scheme to find the important metrics of the system theoretically.
4- Draw the relevant graphs between important metrics of the system from the observed measurements.
5- Compare the experimental results with that of theoretical ones and infer the conclusions.

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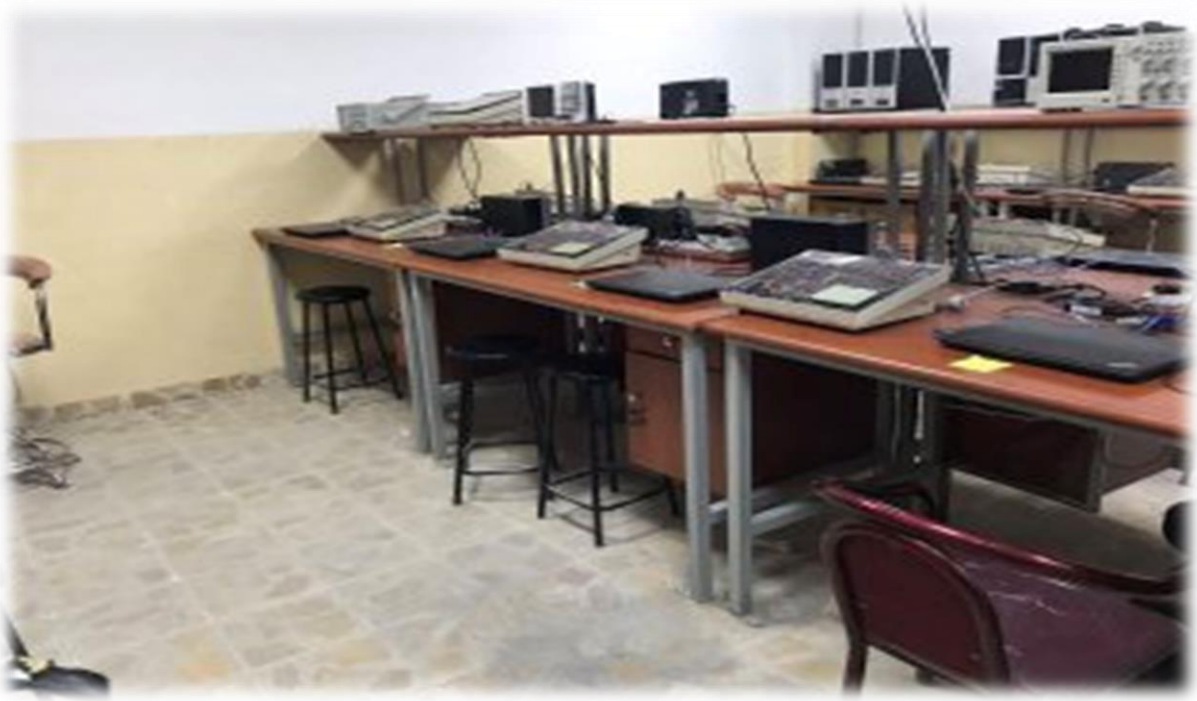
مختبر برمجة المعالجات

Microprocessor Programming Lab

3rd Class(2024_2025)



Laboratory Supervisor: Dr. Sahar Lazim Qaddoori

Laboratory Assistant: Dr. Sarmad F. Ismaeel

Mr. Younis Saber Othman

Introduction:

The Microprocessor Lab is the place where students will learn how to deal practically with the 8086 Microprocessor instruction set. It provides the students with the required tool to program, execute, examine and check the results of their written programs. In the Microprocessor Lab there are basic and simple (yet practical) Hardware and Software tools like PCs, MTS-86C Kits, and Oscilloscopes. The programs that are applied during the experiments are MS-DOS DEBUG, Macro Assembler MASM, Hyper Terminal, and Text Editor. Using these tools the students will improve their understanding of and programming skills of the 8086 instructions set of the IBM based PCs.

Laboratory Objectives:

1. **Develop Basic and advanced Programming Skills using DEBUG commands and Macro Assembler MASM**: The student will become familiar with the internal structure of the x86 microprocessor register set and the Microsoft DEBUG utility, that can be used to debug programs by allowing the student to examine memory and register contents, assembling and disassembling programs, single-stepping, and a variety of other functions. Modify contents of memory, registers, flags register and address space. The student will learn all the command of the MS-DOS Debug program. Also, to learn to use and interpret the various addressing modes of the 8086 microprocessor, and to gain facility with use of the processor registers and memory locations.

2. **Teach Students How to Write an Assembly Program, Execute it, and Exam the Results**: Enable students to learn to write an assembly language programs using Debugger; as well as the Macro Assembler (MASM) to assemble and link a program and use the DOS debugger to debug execution programs. The student will practice programming using the transfer instructions to perform transfer operations. using logical instructions to perform logical operations, using MUL and DIV instructions to perform unsigned multiplication and division, and the IMUL and IDIV instructions to perform signed multiplication and division; using some of the

useful INT 10H subroutines which are burned into the ROM BIOS of the IBM PC and compatibles and to use some of the useful DOS INT 21H functions. The student will learn to code assembly language instructions to perform arithmetic operation (addition, subtraction, multiplication and division) on packed and unpacked BCD numbers, and on ASCII data. The student will experience practically the unconditional and conditional jump instructions of the 8086; and to use the jump and call instructions of the 8086 including short and long jump modes.

3. **Equip Students with Skills to Work with MTS-86C Kit and Hyper Terminal**: To teach the student to become familiar with the MTS-86C microcomputer trainer, examine the function of keypad, and learn how to program the MTS-86C. As well as enabling the student how to deal with the I/O ports, how to read the status of push button (tact) SW 0-7, how to output data on LEDs 0-7, understanding the operation of the 7-segment display, and how to use the lookup table for encoding. Also, to illustrate to the student how to use the hyper terminal to download the hex format (machine language) files from PC on the MTS-86C microcomputer. How to use the debug instructions of hyper terminal to the downloaded programs on MTS-86C microcomputer.

Learn how to deal with ADC0809 and DAC0808 of the MTS-86C Kit. Learn how to deal with analog multiplexer and use one A/D to convert more than one analog signal. Convert real analog signals to digital data via sensors and the A/D converter. In addition to generate different waveforms using DAC0808. The student will know how to Convert real analog signals to digital data via sensors and the A/D converter. Understand how the MTS-86 Kit's-microphone will be used to input sound & voice to the input of ADC 0809 through a sample & hold circuit. Learn how to replayed the recorded data and send it to the DAC 0808.
The student will be experienced practically the meaning of interrupt (INT), Interrupt Vector Table (IVT), clarify the difference between Hardware & Software Interrupts, and explain the method of using interrupts to execute a specific operation through the MTS-86C kit.

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First Semester:

second semester:

Ninevah University
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مختبر المتحسسات الدقيقه والمعالجات المسيطرة

FPGA& Microcontroller Laboratory

4th Class(2024_2025)

Laboratory Supervisor: Noor Talal Gadawe

Laboratory Assistant: Rasha Waleed Hamad

Introduction to FPGA Lab

An FPGA (Field-Programmable Gate Array) lab serves as an introductory platform to the world of reconfigurable digital hardware design. It aims to familiarize students with the fundamental concepts, tools, and methodologies involved in designing and implementing digital systems directly in hardware using FPGAs.

Typically, an introductory FPGA lab will:

- Introduce the concept of programmable logic: Explain what FPGAs are, their key characteristics (reconfigurability, parallelism), and how they differ from microprocessors and Application-Specific Integrated Circuits (ASICs).
- Familiarize with the FPGA development environment: Introduce the industry-standard software tools (e.g., Xilinx Vivado/Vitis, Intel Quartus Prime) used for designing, simulating, synthesizing, implementing, and programming FPGAs.
- Provide hands-on experience with Hardware Description Languages (HDLs): Start with basic syntax and constructs of a chosen HDL (usually Verilog or VHDL) and guide students through writing code for simple combinational and sequential logic circuits.
- Illustrate the FPGA design flow: Walk students through the different stages of the design process, from design entry to bitstream generation and hardware implementation.
- Introduce basic digital building blocks: Implement fundamental digital circuits like logic gates, adders, multiplexers, flip-flops, and counters on the FPGA to understand their hardware realization.
- Demonstrate simulation and verification: Teach students how to use simulation tools to verify the functional correctness of their HDL designs before implementing them on actual hardware.
- Introduce FPGA development boards: Familiarize students with the hardware platform they will be using, including its basic components like switches, LEDs, and clock sources.
- Provide simple hardware implementation examples: Guide students through the process of mapping their designs onto the FPGA board and observing the hardware behavior.

The initial focus is on building a foundational understanding of digital design principles and how they are translated into physical hardware using FPGAs. This lays the groundwork for more complex and advanced topics explored in subsequent FPGA labs.

Introduction to Microcontroller Lab

A microcontroller lab, at its introductory level, aims to provide students with a foundational understanding of embedded systems development using microcontrollers. It focuses on the architecture, programming, and basic interfacing of these versatile single-chip computers.

A typical introductory microcontroller lab will:

- Introduce the concept of microcontrollers: Explain what microcontrollers are, their key components (CPU, memory, peripherals), and their applications in embedded systems.
- Familiarize with a specific microcontroller architecture: Introduce a popular microcontroller family (e.g., 8051, PIC, AVR, ARM Cortex-M) and its basic architectural features, including the CPU core, memory organization, and peripheral units.
- Introduce the microcontroller development environment: Familiarize students with the Integrated Development Environment (IDE), compiler, and programmer used for writing, compiling, and uploading code to the microcontroller.
- Provide basic programming experience: Start with fundamental programming concepts in a language suitable for microcontrollers (often assembly language initially to understand the hardware better, followed by embedded C for higher-level programming).
- Illustrate basic input/output (I/O) operations: Guide students through programming the microcontroller's digital I/O pins to control LEDs, read switches, and interact with simple external components.
- Introduce the concept of delays and timing: Demonstrate how to generate time delays using software loops or hardware timers within the microcontroller.

- Introduce basic interfacing concepts: Begin with simple examples of interfacing the microcontroller with output devices (like LEDs and basic displays) and input devices (like push buttons).
- Familiarize with the microcontroller development board: Introduce the specific development board being used, its features, and how to connect external components to it.

The initial emphasis is on understanding the fundamental principles of microcontroller operation, basic programming techniques, and how to interact with the physical world through simple input and output operations. This forms the basis for exploring more advanced microcontroller features and interfacing techniques in later labs.

Laboratory Objectives:

The primary goal of an FPGA lab is to equip students with the knowledge and practical skills to design, implement, and test digital systems using FPGAs. This typically involves:

- Understanding FPGA Architecture: Learning about the internal structure of FPGAs, including Configurable Logic Blocks (CLBs), interconnects, I/O blocks, and specialized resources like Block RAMs and DSP units.
- Hardware Description Languages (HDLs): Gaining proficiency in using HDLs like Verilog or VHDL to describe digital circuits at different levels of abstraction (behavioral, register-transfer level, structural).
- Digital System Design: Implementing various combinational and sequential logic circuits, such as adders, multipliers, counters, finite state machines, and memory interfaces.
- FPGA Design Flow: Understanding and applying the complete FPGA design flow, which includes:
  - Specification: Defining the system requirements.
  - Design Entry: Writing HDL code or using schematic capture tools.
  - Synthesis: Translating the HDL code into a gate-level netlist optimized for the target FPGA architecture.
  - Implementation: Placing and routing the logic on the FPGA device.

- Simulation: Verifying the functionality of the design before hardware implementation using simulation tools.
- Hardware Implementation: Generating a bitstream and programming it onto the FPGA board.
- Testing and Debugging: Verifying the design's behavior on the actual hardware using various debugging techniques and tools.

- Interfacing with Peripherals: Learning how to interface FPGAs with external components like sensors, actuators, memory devices, and communication interfaces (e.g., UART, SPI, I2C).
- Real-world Applications: Exploring the use of FPGAs in various application domains such as digital signal processing, image processing, embedded systems, high-performance computing, and hardware acceleration.
- Developing Problem-Solving Skills: Enhancing analytical and problem-solving skills by tackling complex digital design challenges.
- Using Industry-Standard Tools: Gaining hands-on experience with professional FPGA development tools from vendors like Xilinx (Vivado, Vitis) and Intel (Quartus Prime).

The main objective of a microcontroller lab is to provide students with a comprehensive understanding of microcontroller architecture, programming, and interfacing techniques for embedded system development. This typically includes:

- Understanding Microcontroller Architecture: Learning about the internal components of a microcontroller, such as the CPU core, memory (RAM, ROM/Flash), timers/counters, serial communication interfaces (UART, SPI, I2C), Analog-to-Digital Converters (ADCs), Digital-to-Analog Converters (DACs), and input/output (I/O) ports.
- Assembly Language and Embedded C Programming: Developing skills in programming microcontrollers using both low-level assembly language for direct hardware control and high-level embedded C for more complex applications.
- Interfacing with Peripherals: Learning how to interface microcontrollers with various external devices, including:
  - Input Devices: Keypads, switches, sensors.

- Output Devices: LEDs, displays (LCD, 7-segment), actuators (motors, relays).
- Communication Modules: Serial interfaces (UART, SPI, I2C), wireless modules (Bluetooth, Wi-Fi).

- Interrupt Handling: Understanding and implementing interrupt mechanisms for efficient and responsive system design.
- Timer and Counter Applications: Utilizing timers and counters for generating delays, measuring events, and implementing pulse-width modulation (PWM).
- Analog Input and Output: Working with ADCs to read analog sensor data and DACs to generate analog control signals.
- Embedded System Development Process: Understanding the typical workflow for designing and implementing embedded systems, including requirements analysis, hardware design, software development, testing, and debugging.
- Real-world Applications: Exploring the wide range of applications for microcontrollers in areas like automation, robotics, consumer electronics, medical devices, and the Internet of Things (IoT).
- Using Development Tools: Gaining experience with microcontroller development boards, Integrated Development Environments (IDEs), compilers, debuggers, and programmers.

In summary, while both FPGA and microcontroller labs deal with digital hardware and embedded systems, FPGA labs focus on the design and implementation of custom digital logic circuits using programmable hardware, emphasizing hardware description languages and the FPGA design flow. Microcontroller labs focus on using pre-designed processor cores and peripherals to build embedded systems through programming and interfacing, emphasizing software development and interaction with the real world.

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Ninevah University
College of Electronics Engineering
Electronic Engineering Dept.

مختبر السيطرة والكترونيات القدرة

Control and Power Electronics Laboratory

4thClass(2024_2025)

Laboratory Supervisor: Dr . Harith Ahmed

Laboratory Assistant: Dr. Harith Hazim

Maysara abduljabbar

Marwa Essam,

Yathrib Waleed

Tawfeq Kalid

Introduction:

The Control and Power Electronics Laboratory is a vital component of the electrical engineering curriculum, providing students with hands-on experience in modern control systems, power electronics, and automation technologies. This laboratory bridges theoretical knowledge with practical applications, preparing students for challenges in industrial automation, energy systems, and advanced electronic control.

Key Experiments and Modules:

Control Systems: Students engage with feedback control systems, modeling, and simulation using tools like MATLAB/Simulink. They design and analyze controllers such as PID and lead-lag compensators, gaining insights into system stability and performance.

Programmable Logic Controllers (PLC): The lab introduces PLC programming and implementation, enabling students to develop automation solutions for industrial processes, including sequential control and interlocking systems.

Power Electronics: Experiments focus on the operation and analysis of power electronic converters, including rectifiers, inverters, and choppers. Students learn about switching devices like thyristors and IGBTs, and their applications in power conversion.

Electronic Drives: The laboratory covers the control of electric motors using electronic drives. Students explore speed and torque control methods for DC and AC motors, understanding the integration of drives in automation systems.

Laboratory Objectives:

1. Acquire Theoretical and Practical Knowledge: Enable students to understand the fundamental principles of control systems and power electronics, including the operation of electric machines, transformers, and related applications.
2. Develop Practical Skills: Provide students with hands-on opportunities to design, implement, and analyze electrical and electronic circuits and systems in real-world working conditions.
3. Utilize Modern Automation Tools: Teach students how to use
4. Programmable Logic Controllers (PLCs) and other modern automation tools to develop efficient solutions for industrial applications.
5. Understand Power Conversion Techniques: Enhance the ability to analyze and design power converters, inverters, and related systems used in modern applications, including renewable energy and electric vehicles.
6. Develop Problem-Solving Skills: Encourage critical thinking and problem-solving through practical experiments and data analysis, enhancing students' capacity to navigate new ideas and technologies in the electronics field.
7. Stimulate Creativity and Innovation: Encourage students to develop innovative projects related to general electronics and power applications, contributing to their competitive edge in the job market.

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Power Electronics Experiments:-

PLC Experimens:-

1-Simulation on WPLSoft ladder program for Delta PLC.

2-Car Parking System.

3-Two Lines Traffic Light System With HMI Control.

4-Programming the Password for Electric Gate With HMI Control.

Control Experimens:-

1- study the transfer function in control system

2- block diagram reduction

3- PID control

4- speed control system using PID controller

Electronic Drives Experimens:-

1-Single phase uncontrolled rectifier

2-Single Phase Full-Bridge Inverter with Inductive-Resistive Load

3-DC to DC Converter(Buck converter, Speed control of dc motor with buck converter based on PI)

4-Boost converter and Boost converter with PI controller