IEEE
CAIRO UNIVERSITY STUDENT BRANCH
IEEE
CUSB

ieeecusb

Embedded AVR Work Content

2025-2026

IEEE CAIRO UNIVERSITY STUDENT BRANCH

Detailed Session Guide (Instructor Version)

- For every session, we define **three things**:
  - Session Content (what is taught)
  - In-Session Assignment (done live with instructor)
  - Pre-Session Task (home task before next session)
  - The students will deliver their task in their own repo

Detailed Continuous Session Plan (Final Version)

Session 1 – Embedded Systems Concepts

Session Content

- What is Embedded Systems?
- Microcontroller vs Microprocessor
- AVR family overview
- Memory map (Flash / SRAM / EEPROM)
- Registers
- Datasheet reading
- Clock system
- Polling vs Interrupt

In-Session Assignment

- Read ATmega32 datasheet:
  - Identify GPIO registers
  - Identify ADC block

Pre-Session Task

- Short technical report:
  - Where is DDR register located?
  - Difference between SRAM and Flash

Session 2 – C Programming (Part 1)

Session Content

- GitHub Intro
- Data types
- Operators
- if / switch
- for / while loops
- Bitwise operations

In-Session Assignment

- Implement basic bit manipulation functions:
  - SetBit()
  - ClearBit()

Pre-Session Task

- Implement:
  - ToggleBit()
    (Using only bitwise operations)

Session 3 – C Programming (Part 2)

Session Content

- Functions
- Arrays
- Pointers
- Structs
- Macros (#define, #if)
- Header files
- Header guards

In-Session Assignment

- Build reusable **Calculator Driver**:
  - Add()
  - Sub()
  - Mul()
  - Div()

Pre-Session Task

- Create a **Mini Matrix Library**:
  - matrix.c / matrix.h
  - Support:
    - Matrix addition
    - Matrix subtraction
      (Using structs + pointers only)

Session 4 – GPIO + Layered Architecture

Session Content

- MCAL vs HAL vs APP
- GPIO registers
- Input vs Output
- Pull-up vs Pull-down

In-Session Assignment

- Build:
  - Button → LED system
  - Using layered architecture

Pre-Session Task

- Design:
  - Traffic light system with ON/OFF button

Session 5 – LCD & Keypad

Session Content

- LCD interfacing
- Keypad scanning

In-Session Assignment

- Display:
  - Keypad value on LCD

Pre-Session Task

- Extend Traffic Project:
  - Add LCD
  - Add keypad password system

Session 6 – Interrupts

Session Content

- ISR concept
- External interrupts
- Global interrupt enable

In-Session Assignment

- External interrupt:
  - Button → Toggle LED

Pre-Session Task

- Extend Traffic Project:
  - Add emergency interrupt button

Session 7 – Timers & ICU

Session Content

- Timer modes
- Prescalers
- Input capture

In-Session Assignment

- Two LEDs:
  - One blinks fast
  - One blinks slow

Pre-Session Task

- Modify Traffic Project:
  - Replace delays with hardware timers

Session 8 – PWM & ADC

Session Content

- Analog vs Digital
- PWM
- ADC

In-Session Assignment

- Potentiometer controls LED brightness

Pre-Session Task

- Extend Traffic Project:
  - Add motor
  - Potentiometer controls speed

Session 9 – UART

Session Content

- Serial communication
- Baud rate
- TX / RX

In-Session Assignment

- Send:
  - Sensor data to PC

Pre-Session Task

- Extend Traffic Project:
  - Add second MCU
  - One sends data, one displays on LCD

Session 10 – I2C & SPI

Session Content

- I2C vs SPI
- Master / Slave
- Real devices

In-Session Assignment

- Use:
  - LCD over I2C

Final Task

- Final Project:
  - Choose idea
  - Draw block diagram
  - Define peripherals
  - Prepare documentation