

STM32 HAL (Hardware Abstraction Layer) programming using **STM32CubeIDE** allows developers to interact with the STM32 microcontrollers in an easier and more structured way. STM32CubeIDE, a development tool from STMicroelectronics, integrates code generation, debugging, and programming features in one environment, making it ideal for learning HAL programming.

Here's a structured description of learning **STM32 HAL programming** using **STM32CubeIDE**.

□ **Overview of STM32 Microcontrollers:**

- Introduction to the STM32 family of microcontrollers, their architecture, and peripheral features.
- Application areas of STM32, including automotive, industrial, and IoT.

□ **STM32CubeIDE:**

- STM32CubeIDE is an integrated development environment (IDE) that combines the functionality of **STM32CubeMX** (code generator) with advanced debugging and programming features.
- Familiarization with the IDE layout: Project Explorer, Editor, Peripheral Configuration, and Debugger.

□ **STM32 HAL (Hardware Abstraction Layer):**

- HAL is a high-level library that abstracts the low-level peripheral registers of STM32, providing simpler functions to configure and use the peripherals.
- The benefits of HAL over direct register manipulation (ease of use, portability).
- **STM32CubeMX Overview:**
 - Introduction to STM32CubeMX as a graphical tool for peripheral configuration, clock setup, and middleware integration.
 - Using STM32CubeMX to select an STM32 MCU or development board.

Project Setup in STM32CubeIDE:

- Create a new project in STM32CubeIDE using STM32CubeMX.
- Choosing the right **STM32 MCU/board** (e.g., STM32F4, STM32L4, STM32F7, Nucleo boards).

Peripheral Configuration:

- Graphically configure peripherals (GPIO, UART, I2C, SPI, Timer, ADC, etc.) using STM32CubeMX.
- Clock configuration (HSE, LSE, PLL settings) using CubeMX clock configuration tool.
- Automatically generate initialization code for peripherals.

Module 4: EMBEDDED (STM 32 Using HAL programming) - 2 Hours / Day

DAYS	PARTICULARS
Day 1	STM32 Basic Overview – STM32F, – OSI Layers and Applications (Advance than other controller), STM32CubeMX CONFIG, STM32CUBEIDE Programming and Debugging
Day 2	STM 32 Internal Architecture and Interface Protocol
Day 3	STM32 GPIO Configuration (LED,Switch,7-segment,LCD,Matrix keypad)
Day 4	ADC (Sensor interfacing)
Day 5	Timer and its interrupts
Day 5	CCP module(Capture, Compare, PWM)
Day 7	DAC
Day 8	Communication protocols(UART,I2C,SPI)
Day 9	I2C With OLED
Day 10	SPI with EEPROM
Day 11	CAN protocol implementation
Day 12	Bootloader overview
Day 13	Blue tooth module, GSM module interfacing
Day 14	GPS,Lora module interfacing
Day 15	RFID interfacing, Motor control
Day 16- Day 25	Project Work Prototype