



Duration: 6 Months

EMBEDDED C

MODULE 1: BEGINNING THE COURSE

- Embedded C Vs C
- Data Types and Memory Classification
- Revising Number System
- Variables and Syntax
- Operators
(Arithmetic/Unary/Relational/Logical/Ternary/Bitwise)
- Macros
- Enumerations
- Type Def
- Storage Classes
(auto/static/register/extern)
- Constant and Volatile
- Understanding Structures and Unions
- Software Installation and Environment Overview
- Simple Electronic Circuit Interfacing
- Circuit Simulation

MODULE 2: INTRODUCTION TO A MICROCONTROLLER

- Pin, Block, Memory Diagram
- Understanding the Microcontroller Datasheet
- Introduction to the Programmable Registers

MODULE 3: INTRODUCTION TO LED INTERFACING

- Interfacing a simple LED, RGB LED
- Interfacing Multiple LEDs
- Understanding Delays
- Generating LED patterns

MODULE 4: INTRODUCTION TO LOOPS

- Using for loop to generate LED Pattern
- Using While loop to generate LED Pattern

MODULE 5: INTRODUCTION TO SEVEN SEGMENT DISPLAY INTERFACING

- Interfacing a Seven Segment Display
- Creating Single Digit Up & Down Counter
- Interfacing Multiple Seven Segment Display
- Creating Multiple Digit Up Counter
- Creating Multiple Digit Down Counter

MODULE 6: INTRODUCTION TO ARRAYS

- Creating Arrays for Seven Segment Display
- Using Loops for Generate Counters
- Seven Segment Matrix Interfacing
- 4 and 6 digit Display Interfacing

MODULE 7: INTRODUCTION TO SWITCH INTERFACING

- Understanding If and Else Statements
- Single Switch to Control LED
- Concept of Pull-Up/Pull-Down
- Understanding Nesting and Ladder If-Else Statements
- Multiple Switch to Control RGB LED
- Understanding Pin Targeting and Delayed Switching
- Single Switch to control Seven Segment Display
- Multiple Switch to Create Up and Down Counter
- Understanding Switch Debouncing

MODULE 8: INTRODUCTION TO MOTOR INTERFACING

- Types of Motors
- Interfacing a DC Geared Motor
- Understanding the DC Geared Motor Driver



- Using Switch to Control DC Geared Motors
- Interfacing a Stepper Motor
- Using Switch to Control Stepper Motor

MODULE 9: INTRODUCTION TO FUNCTIONS

- Understanding Types of functions
- Creating Functions for LED Pattern Interfacing
- Creating Functions for Motor Interfacing
- Understanding Switch-Case Statements
- Understanding Return from a function
- Creating Function for Seven Segment Display Interfacing
- Understanding Character Arrays and Pointers
- Understanding Reference and Dereference Pointers
- Understanding String and Special Characters

MODULE 10: INTRODUCTION TO CHARACTER LCD INTERFACING

- Understanding LCD Pinouts and Commands
- Creating Functions for LCD 8-bit Command Mode
- Creating Functions for LCD 8-bit Display Mode
- Creating Functions for LCD 8-bit Initialization
- Creating Functions for LCD 4-bit Command Mode
- Creating Functions for LCD 4-bit Display Mode
- Creating Functions for LCD 4-bit Initialization
- Printing Character Array using Loops
- Printing String using Loops

- Creating Function to Print String using Library functions
- Understanding Recursion & its drawbacks

MODULE 11: INTRODUCTION TO SENSOR INTERFACING

- Analog to Digital Conversion
- Understanding ADC registers
- Types of Sensors (Potentiometer/LDR/DHT11/LM35)
- Interfacing Sensors with LED
- Interfacing Sensors with Seven Segment
- Interfacing Sensors with Motor
- Displaying the Sensor Data on LCD
- Interfacing with Infrared Sensors
- Interfacing with Ultrasonic Sensors
- Interfacing a Mechanical Relay for AC Load

DEVELOPING MINI PROJECT 1: WEATHER STATION

DEVELOPING MINI PROJECT 2: SENSOR BASED AC LOAD CONTROLLER

EMBEDDED SYSTEM USING AVR

MODULE 1: REVISITING THE EMBEDDED C PROGRAMMING

- Variables and Operators
- Conditions - Nested and Ladder
- Loops, Functions and Pointers
- Macros and Enumerations

MODULE 2: BASIC ELECTRONICS SIMULATION

- Software Installation and Environment Overview



- Simple Electronic Circuit Designing and Hardware Interfacing
- Circuit Simulation

MODULE 3: INTRODUCTION TO ATMEGA16 MICROCONTROLLER

- Features of ATmega16 Microcontroller
- Understanding Pin Diagram
- Atmega16 Block Diagram and Peripherals
- ATmega16 Basic Programmable DATA Registers
- Controlling the PORT and PIN in Atmega16

MODULE 4: TESTING THE BASIC IO UTILITY

- LED Interfacing - Simple and Pattern
- Seven Segment Display Interfacing - Simple and Multiplexed
- Switch Interfacing - Single, Multiple and Keypad
- DC Geared Motor Interfacing
- Stepper Motor Interfacing
- LCD Interfacing - 4bit Mode
- LCD Interfacing - 8bit Mode
- Relay Interfacing to control AC Load

MODULE 5: ANALOG TO DIGITAL CONVERTOR

- Understanding the ADC Registers
- Single Conversion and Repeated Conversions
- Interfacing Single sensor using ADC (Normal Mode)
- Interfacing Multiple sensor using ADC (Normal Mode)
- Interfacing Single sensor using ADC (Differential Mode)
- Interfacing Multiple sensor using ADC (Differential Mode)

MODULE 6: INTERRUPT HANDLER

- Understanding Interrupt Utility
- Understanding the Interrupt Registers
- Difference between Polling and Interrupt
- Identifying Interrupt Vectors and Priority Table
- Interrupt Service Routine
- Creating and Initializing Interrupts
- Interfacing Sensor with Interrupt Service Routine
- Interfacing with External Interrupts

MODULE 7: TIMER AND COUNTERS

- Understanding Timers and Counter Peripheral
- Understanding the Timer Registers
- Generating 1us Pulse on IO
- Generating 1ms Pulse on IO
- Creating User Defined Delay Function
- Understanding Timer CTC Mode
- Creating 100KHz Frequency Generator
- Understanding Timer PWM Mode
- Interfacing LED Dimmer using PWM
- Interfacing Servo Motor using PWM
- Understanding Timer ICP Mode
- Creating a Frequency Detector using ICP Mode

MODULE 8: UNIVERSAL ASYNCHRONOUS RECEIVER TRANSMITTER

- Understanding the features of UART Protocol
- Understanding the UART Registers
- Creating a Serial Data Transmitter Function
- Creating a Serial Data Receiver Function
- Interfacing a Serial Communication Device using UART



MODULE 9: SERIAL PERIPHERAL INTERFACE

- Understanding the features of SPI Protocol
- Understanding the SPI Registers
- Creating a Master Data Out Function
- Creating a Master Data in Function
- Interfacing a Multiple Slave Environment using SPI

MODULE 10: INTER INTEGRATED CIRCUIT

- Understanding the features of I2C Protocol
- Understanding the I2C Registers
- Creating a Write Function
- Creating a Read Function
- Interfacing RTC DS1307 using I2C

DEVELOPING A MAJOR PROJECT

EMBEDDED SYSTEM USING ARM

MODULE 1: REVISITING EMBEDDED C

- Basic Keywords
- Operators
- Syntax and Formatting
- Loops and Conditions
- Functions
- Structures, Enumerations and Typedef
- Types of Interfaces

MODULE 2: STM32-THE BEGINNING

- Datasheet Description
- Block Diagram and Memory Mapping
- GPIO Configuration Registers
- Reset and Clock Control Registers
- GPIO Data Registers

MODULE 3: SIMULATION AND DEBUGGING

TOOL

- Introduction to Simulation and Debugging Environment
- Basic Circuit Designing for Simulator Testing and Debugging

MODULE 4: STM32-BASIC PERIPHERAL INTERFACING

- Simple LED
- Sequence of LEDs
- LED in a Matrix
- Push Button / Switch
- Multiple Switch
- Switch in a Matrix / Keypad
- Buzzer
- 16x2 Liquid Crystal Display in 8-bit mode
- 16x2 Liquid Crystal Display in 4-bit mode
- AC Load using Relay
- Generating System Delay
- Developing Libraries for Delay Generation

MODULE 5: STM32-ANALOG SENSOR INTERFACING

- Simple Analog to Digital Converter
- Setting UP Registers for ADC
- Reading Voltage Data
- Interfacing Temperature sensor
- Interfacing Light Dependent Resistor
- Developing Libraries for ADC

MODULE 6: STM32-HANDLING INTERRUPTS

- Setting Up Interrupt Generation
- Interrupt Service Routine
- Priority Table for Interrupts
- External Interrupts
- Internal Interrupts

MODULE 7: STM32-TIMERS AND COUNTERS



- Counter Operations
- Setting Up Registers
- Generating Time using Counter
- Timer CTC Operation
- Timer PWM Operation
- Timer Input Capture Operation
- Developing Libraries for Timers

MODULE 8: STM32 - USART

- Understanding Protocol
- Setting Up Registers
- USART-Transmitter Module
- USART-Receiver Module
- Developing Libraries for USART
- Communication between Transmitter and Receiver Device

MODULE 9: STM32 - SPI

- Understanding Protocol
- Setting Up Registers
- SPI-Master Module
- SPI-Slave Module
- Developing Libraries for SPI
- Communication for Single Master Single Slave
- Communication for Single Master Multi Slave

MODULE 10: STM32-12C

- Understanding Protocol
- Setting Up Registers
- 12C-Master Module
- 12C-Slave Module
- Developing Libraries for I2C
- Communication between Master and Slave Device

MODULE 11: STM32 - DEBUGGING

- Direct Memory Access on STM32

Debugger

- Generating Hex File
- Loading Hex Files on microcontroller
- Functional Verification of microcontroller using registers

PCB DESIGN

MODULE 1: INTRODUCTION TO CIRCUIT DESIGNING

- Need of Circuit Designing
- Introduction to Electronic Components
- How to Select Components
- Basic Circuit Designing Process
- Types of PCB's used
- The Designing Process

MODULE 2: INTRODUCTION TO CIRCUIT SIMULATION TOOL

- Exploring the Simulation Tool
- Adding and Exploring Component libraries
- Creating 5VDC Multivibrator Circuits
- Adjusting Voltage, Current and Values of Components
- Creating 220VAC Power Circuits
- Connection Troubleshooting

MODULE 3: INTRODUCTION TO ALTIUM 20 TOOL

- Exploring the Tool Environment
- Creating New Project Files
- Loading components in Library
- Working on component schematic
- Working on component footprint
- Working on component 3D model
- Setting up annotations, marking and properties



MODULE 4: DEVELOPING A SCHEMATIC

- Schematic sheet setup
- Keyboard shortcuts for schematic sheet
- Placing components in schematic
- Annotation of the components
- Routing the schematic
- Working on net class
- Adjusting net parameters
- Working on port connections
- Design rule check
- Compiling project and document generation
- Adding text, snape and image
- Troubleshooting Warnings and Errors
- Printing Schematics

MODULE 5: DEVELOPING A LAYOUT

- Configuring the board properties
- Understanding the board layers
- Setting up the rules
- Placing components in layout
- Routing the components
- Working on copper pouring
- IPC Standard Rules and Conventions
- Multiple Layer Routing
- Placing Ground and Power Planes
- Design rule check
- Adding text, shape and image
- Troubleshooting Warnings and Errors
- Generating Gerber Files
- Generating N/C Drill Files
- Working on 3D View
- Generating 3D View Files

MODULE 6: PCB PRINTING AND ETCHING PROCESS

- Printing the Layout
- Developing copper clad layout
- Etching the clad
- Drilling for holes
- Mounting components and Soldering
- Troubleshooting