

IoT Embedded

Duration- 6 Month

RECAP of EMBEDDED C

- Datatypes
- Array
- Conditional Statements
- Functions / Callback function
- Structures
- Pointers
- Storage classes

EMBEDDED SYSTEM

- Basic Concepts
- Sensors/Actuators
- Microcontroller units and Architecture (Arduino)
- Interfaces (serial port, SPI, I2C, UART)
- ADC, Timers, RTC, Interrupts, Polling, DMA
- Memory architecture and handling (stack, heap, cache)
- Application driven Selection of Microcontrollers

IOT ARCHITECTURE

- Architecture.Tech Stack.
- Hardware Development Platforms
- Software Development Platforms
- Communication Protocols
- Power Requirements in IoT
- Cloud, its components and IoT
- Data Streaming and IoT
- Data Store and IoT

- Analytics & Visualization and IoT
- IoT Security

NODEMCU (ESP8266)

- Install IDE Software
- Introduction to NODEMCU(Esp8266)
- Pinout of NODEMCU
- Programming Of NODEMCU
- Weather monitoring solution
- Automatic street lights

COMMUNICATION

- Introduction to communication architecture - Network protocol stack
- Different protocols
- RF: ZigBee, Bluetooth, BLE, Zwave, Google thread, Mesh network.
- Communication Channels: GSM/GPRS, 2G, 3G, 4G, LTE, WiFi, PLC
- LPWAN - LoRa & LoRaWAN, Sigfox, Weightless. 3GPP - NB-IoT, LTE -M
- Comparison between different RF Technologies.
- IPv4 addressing problem for IOT and introduction to IPV6

ARM MICROCONTROLLER (STM32)

- Introduction to Microcontrollers (Based on Architecture Selected)
- Instruction set architecture - pipelines
- Registers banks/mode and states
- Clock and reset systems, timers and Memory Organisation
- IDE Configuration, Linker Script, Compiler Optimization Options
- Exception/Interrupt handling
- C and Embedded C Migration
- Memory /IO and peripherals - (I2C/SPI/UART/GPIO/Timer/PWM/ADC)
- Debugging tools like JTAG debugger, CRO
- MMU
- CubeMX

ARM PROCESSOR AND ARM BASED SUBSYSTEM

- ARM Processor Architecture
- Memory /IO and peripherals - (I2C/SPI/UART/GPIO/Timer/PWM/ADC)
- Debugging tools like JTAG debugger, CRO
- MMU
- ARM Based Embedded Subsystem Architecture
- Multicore Architecture

PYTHON

- Data types and type conversion
- Variables and basic operations
- Flow control
- Loops
- Lists, Set and Tuple
- Dictionary
- Functions
- File Handling
- Class and Objects
- Error/ Exception Handling

RPI

- Introduction to Raspberry pi
- Setup and installation
- Raspberry pi OS walkthrough
- Network setup
- Code execution and data generation
- Sending data to cloud

EMBEDDED LINUX

LINUX INTERNALS

- Linux internals
- Linux introduction and installation.
- Linux Shell Commands
- Shell Scripting
- C Programming in Linux
- Make Files
- Process Management
- File Operation
- Signals in Linux
- Linux Scheduler & Memory Management
- Linux Multi-Threading Programming
- Inter Process Communication (Pipes, Semaphores, Queues, SharedMemory)
- Network Programming in Linux

SOCKETS

- Socket connection
- Socket Attributes
- Creating a Socket
- Socket Addresses
- Naming a Socket
- Creating a Socket Queue
- Accepting Connections
- Requesting Connections
- Closing a Socket
- Socket Communications Processes and Signals
- What is process?
- Process Structure
- The Process Table
- Viewing Processes
- System Processes

MODULE-II: ELINUX PORTING

- Introduction, Setup & Hardware
- Toolchain & Hardware Practical's
- Bootloader U-Boot

- U-Boot Porting
- Customizing Bootloader
- Linux Kernel
- Kernel Porting & Compilation
- Kernel Modification
- Root File System
- Embedded Application Development

MODULE-III: LINUX - DEVICE DRIVERS

- Introduction and Arch of Linux Device Drivers
- Kernel Module Programming
- Character Device Drivers
- Interrupts in Device Driver
- Interrupt Handling & Bottom Half
- Process creation calls (fork,vfork,execv)
- LDDM (Linux Device Driver Model)
- Writing and testing of Board File
- Device Tree
- Advance Device Drivers
- Debugging Techniques using GDB & valgrind other tools.

INTER-PROCESS COMMUNICATION

- Pipes
- Semaphores, message queues and shared memory
- Shared Memory
- Message Queues

MODULE-IV: YOCTO

- Yocto Architecture
- Recipes defines everything in Yocto
- Layers makes Yocto Modular & Structured
- Adding new Hardware support using BSP Layers
- Custom Distribution & Images
- Creating SDK using Yocto for Application Development

IOT PROTOCOLS

- Yocto HTTP/REST, MQTT, COAP, AMQP, WEBSOCKETS, 6LoWPAN

NODE-RED

- Installation of Nodejs,
- Installation of Node-Red,
- Building your first flows
- Basic nodes and flows
- A tour of the core nodes
- The Node-RED programming model
- Dashboards and UI techniques
- Local broker installation,
- Connection between local broker and Node-RED

CLOUD COMPUTING

- Cloud Computing
- Benefits of Cloud
- Deployment Models
- AWS-IOT Core/ Sage-Maker
- Green-grass
- Google IOT Cloud
- Thingspeak
- IBM Bluemix
- AWS
- AZURE
- Google Firebase
- SQL and NoSQL Data bases
- Integration with MySQL
- MongoDB
- IoT Cloud Platform: Device Management

IOT SECURITY

- Introduction to mbed TLS and SSL
- Importance of IoT application
- AES encryption

EDGE AI

- Standards and best practices
- Types of analytics and machine learning
- Supervised/ Un-supervised learning
- Python for IoT analytics
- Computer vision for image data
- Anomaly detection
- Edge Impulse/ TinyML

INDUSTRY4.0

- Introduction to Industry 4.0
- Road to Industry 4.0
- Role of data, information, knowledge and collaboration in future organizations.
- Related Disciplines, System, Technologies for enabling Industry 4.0
- IoT Deployment with legacy systems PLC/SCADA/OPC-UA

USECASES

- Automobile
- Electric Vehicle