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# ANCIT EMBEDDED LINUX TRAINING PROGRAM (320 Hrs)

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# Embedded Linux Training Course Agenda from ANCIT

<b>Delivery Format</b>	:	This Course is offered in Classroom
<b>Duration</b>	:	320 Hours ( 8 Weeks)
<b>Target Group</b>	:	Embedded Engineers, College Freshers with Knowledge of Basic C
<b>Lab Setup</b>	:	<ul style="list-style-type: none"><li>• PC/Laptop with Ubuntu installed machine or virtual box</li><li>• Linux PC /Laptop with Ubuntu22.04 is ideal per participant for the training. Otherwise, participants must have a ubuntu 18.x or ubuntu 22.04 via virtual box using windows</li><li>• <a href="https://www.virtualbox.org/">https://www.virtualbox.org/</a> <a href="https://www.osboxes.org/ubuntu/">https://www.osboxes.org/ubuntu/</a></li><li>• Beagle bone black hardware and accessories (Target hardware)</li><li>• Remaining softwares (u-boot,Kernel, busybox, SDK ) either we can download or install using sudo apt install during the training based on the topics. This is the reason internet access is required.</li><li>• C programming Hands on will be done on Linux x86 virtual machine using gcc compiler</li><li>• Embedded Linux Hands on will be done using both x86 virtual machine and Beagle bone black board.</li><li>• Opensource software will be used in the training.</li></ul>

## Day 1. Introduction to Embedded Systems and C Programming

- uP Vs uC Vs SoC
- Systems Overview (GPS Vs ES Vs RTES)
- Problem Solving
- C Programming Introduction
- Basic Linux commands and compile a C program using gcc
- Compilation Stages
- Memory segments of a binary

## Day 2. Data types, Operators, Control flow

- Data Vs Datatype Vs Data structure
- Key words
- Variables
- Operators
- Control Structures
- Loops

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## Day 3. Arrays and Pointers Overview

- Single dimensional Array
- Double Dimensional array
- Searching Techniques (Linear search and Binary search)
- Sorting Techniques (Bubble Sort and Selection Sort)
- Strings
- Pointers Overview
- Pointer arithmetic

## Day 4& 5. Functions

- Functions overview
- Function types
- Storage Classes
- Recursion
- Linkage

## Day 6. Structures and Unions

- Structure initialization
- Structure Padding
- Avoid structure padding using attributes
- Unions
- Bitfields

## Day 7. Pointers and Preprocessor directives

- Little endian Vs Big endian
- Volatile importance
- Constant pointers
- Dynamic memory allocation
- Functions and pointers
- Structures and pointers
- Preprocessor directives

## Day 8. File Handling

- File Handling
- Console I/O functions
- Stream I/O functions

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## Day 9: Introduction to Linked list

- Array vs Data structure
- Data structures overview
- Single linked List

## Day 10: Linked list and its variants

- Double linked list
- Circular single linked list

## Day 11: Stacks and Queues

- Stacks
- Queues
- Applications

## Day 12: Reserve day for consolidating learning and practice

## Day 13: Lab Assessment on C Programming, Viva on C & DS Module

## Day 14: Baremetal Programming Overview

- Processor Basics
- Introduction to ARM
- Little endian Vs Big endian
- Cortex-M3 Architecture Study - TRM
- Looking into Data Sheets and Schematics

## Day 15: Baremetal Programming

- Memory Mapped I/O
- Protocols Introduction (I2C, SPI)
- BareMetal Programming

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## Day 16. Embedded Operating System Overview

- Why OS?
- GPOS Vs EOS Vs RTOS
- Linux Vs Embedded Linux
- Distribution Vs Embedded distributions
- Software packages
- Kernel subsystems
- File system
- X86 booting process
- Embedded Linux booting Components
- Make file

## Day 17. Building Embedded Linux BSP/SDK Components

- Embedded Linux architecture
- Toolchains
- Boot loader - U-boot Customization
- Understanding Linux kernel and customization

## Day 18. Building Embedded Linux BSP/SDK Components

- File system customization
- Device Tree Understanding
- Embedded Linux booting Techniques

## Day 19. Yocto Overview

- Why Yocto?
- Bitbake
- Recipe basics
- Layers

## Day 20. Reserve day for consolidating learning and practice

## Day 21. File I/O

- User space Vs Kernel space
- User space initialization
- Libraries
- Static Vs Dynamic libraries
- File I/O

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## Day 22. Process

- Multitasking
- Task structure
- Process address space
- Creating a process
- Process states
- Copy On Write

## Day 23. Threads

- Threads
- Threads synchronization

## Day 24. Threads attributes and scheduling concepts

- Thread synchronization (Semaphores and Mutex)
- Scheduling concepts

## Day 25. Reserve day for consolidate learning and practice

## Day 26. Inter Process Communication – Signals

- Signals
- Signal handling

## Day 27. Inter-Process Communication – Pipes

- System V Vs POSIX IPC
- Pipes
- Fifos

## Day 28. Inter Process Communication – Shared Memory and Message Queue

- Communication
- Shared Memory
- Message Queue
- Synchronization
- Binary Semaphores
- Mutex

## Day 29. Inter Process Communication – Sockets

- Socket Programming

## Day 30. Reserve day for consolidate learning and practice

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Day 31. Lab assessment on User space Programming and Viva

Day 32. Linux Kernel Modules

- Kernel Subsystems Overview
- System calls
- Taskstruct
- Device Driver Development
- Dynamic Approach
- Modules
- Printk and priorities
- Module parameters

Day 33. Char driver Implementation

- Char driver registration
- Char driver Implementation
- VFS role
- Application to test

Day 34. Interrupt and Memory management

- Exception Vs Interrupts
- Registering an interrupt
- ISR
- Interrupt handling (Top half Vs bottom half)
- Memory management

Day 35. Reserve day for consolidate learning and practice

Day 36. Driver Frameworks and Synchronization

- Device tree processing in driver
- Driver Frameworks -i2c subsystem (Complete driver flow from application to i2c-dev.c)
- driver methods using printk's)
- Synchronization (atomic and spinlock)

Day 37. Porting drivers

- Porting basics
- Porting drivers

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## Day 38. Debugging

- Kernel debugging techniques
- JTAG debuggers overview
- Trace32 basics
- Trace32 JTAG debugging using simulation
- Debugging tools

Day 39. Reserve day for consolidating learning and practice

Day 40. Lab assessment on Embedded Kernel Programming and Viva



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