

# **Embedded Linux Programming & Device Drivers**

## **Part – 1: Programming Languages**

### **Module 1 Introduction to Embedded Systems**

What are and Why Embedded Systems?, Types of Embedded System, Classifications of Embedded Systems, Characteristics of an Embedded System, Applications of an Embedded Systems, Overview of Embedded Industry, Comparing Layers of GPC & Embedded System

### **Module 2 C Programming**

What are Micro Processors?, What are Micro Controllers?, Difference between Micro controller and Microprocessor, System Design using Microcontroller and Microprocessor, Difference between Von Newman and Harvard Architectures, Difference between CISC & RISC Architectures, Overview of 8 bit,16bit,32bit & 64bit microcontrollers

### **Module 3 Advanced C Programming**

Function, Storage Classes, Scope and Lifetime of a variable, Volatile , Recursive Functions, Stack Frame Analysis, Drawbacks of Functions, GDB, Basic Debugging Commands , Debugging a sample C Program, Arrays, Arrays and Functions, Pointer, Pointer Arithmetic, Pointers and Arrays, Pointers and Functions, String Handling Function like strcpy, strcat, strcmp, strlen, Pointers and Strings, Function Pointers, Variable Augmented Function,

### **Module 4 Data Structure Programming**

Dynamic Memory Allocation, Memory Leaks and Dangling Pointers, Structure, Structures and Array, Structures and Functions, Structure Padding and Alignment, Union, Bit fields, Using Typedefs, Enumerations, Macros

### **Module 5 Embedded C Programming**

Introduction to Data Structures, Types of Arrays, Coding Standard, Linked Lists, Singly Linked List, Doubly Linked Lists, Stacks and Queues.

## **Part – 2: Linux System Programming**

### **Module 6 Linux Basic and Utilities**

Unix / Linux / Windows History, Free Software Foundation, GNU Project, Booting Process of OS ,Advantages and disadvantages of Linux, Features of Linux, Linux root File System, Virtual File system, Linux Kernel version, Shell and Shell Commands , system calls, file handling in Linux, Environmental variables, inodes and file permissions, error handling in linux, data types in linux.

### **Module 7 Programming Language Libraries in Linux**

Shell Programming, Glibc, gcc compiler, gdb debugger, Makefile Utility, Compilation steps, Memory allocation in programming, C++ Library and manpages, Java Library support in Linux, Python and perl Language programming in Linux.

### **Module 8 Linux Kernel Programming**

Linux Kernel Architecture, User & System Mode, Process Management, pid, fork , vfork, exec, orphan process, zombie process, wait, exit, POSIX standards, pthreads, pthread attributes.

### **Module 9 POSIX Thread Programming**

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POSIX standards, POSIX Threads, pthreads, pthread attributes, POSIX Message Queues, POSIX Semaphores, POSIX Shared memory, Asynchronous input and output, Threads in real-time, Multithread Vs Multiprocessing.

### **Module 10 Linux Synchronization Programming**

Need of Synchronization, Deadlock problem, race condition, critical section problem, Atomic operators, Deadlock, conditional variables, Mutex, Semaphores, System v API, POSIX API.

### **Module 11 Linux IPC (Inter Process Communication) Programming**

Need of IPCs, pipe, FIFO, Shared Memory, message queue, Signals

### **Module 12 Linux Network Programming OSI Reference Model**

Introduction to OSI Ref Model, Physical Layer Protocol Functions, Data Link Layer Protocol Functions, Network Layer Protocol Functions, Transport Layer Protocol Functions, Session Layer Protocol Functions, Presentation Layer Protocol Functions, Application Layer Protocol Functions

### **Module 13 Understanding TCP / IP**

Origin of TCP/IP, TCP/IP Model, IP Addressing, Subnet masking, Assigning IP, Overview of Routing process, TCP/IP Stack, TCP/IP Characteristics, TCP/IP Utilities

### **Module 14 Linux Socket Programming**

Socket API, Client Server Architecture, TCP Socket, UDP Socket, RAW Socket, Unix Socket, FTP Programming, Chat Programming, Concurrent Server Programming, Multiple client Programming, Arithmetic server.

## **Part – 3: Linux Device Drivers**

### **Module 15 Fundamentals of Device Drivers**

Linux Driver Module, Role of Driver, Inbuild and Modular Drivers, Types of Device Driver, Relationship between Kernel and Driver, Major and Minor Number, Modular Program Vs. Application Program, Compile, run a sample module, Registering & Un-registering a sample character device, Creating a device file and test character device driver, Hands on Sample module creation, passing arguments to module.

### **Module 16 Developing Character Device Drivers in Linux**

Memory Allocation and Freeing with in modules, IO Port and IOMEM allocation, Registering and Freeing Interrupt Handling, Random Access to the character device, Using Capabilities, Implementing IOCTL Commands, Implementing Kernel Locking Mechanism, Overview of Network, Device Drivers, Overview of Block Device Driver

### **Module 17 Developing Block Device Drivers in Linux**

Driver Registration, Block Device Operation, gendisk structure, Block Device Operation, Request queue, bio structure, request structure, sample driver

### **Module 18 Understanding & Driving UART / RS-232**

Difference between Serial and Parallel Communication, What are DTE and DCE, What are DB9 and DB25 Connectors, Describe the pins of DB9 Connector, What are loop back and Null modem connection, Serial Port Architecture under X86 Architecture, Description of UART Register in X86 Architecture, RS232 Frame Format, Max232/233, a voltage level converter, Programming and Driving RS-232 serial port

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## **Module 19 Parallel Port Device Driver**

Difference between Serial and Parallel Communication, DB25 connector and Centronix connector, Data Register, Control Register, Status Register, Data Input / Output using parallel port, Base Address Accessing , Practical device driver for parport.

## **Module 20 USB Keyboard Device Driver**

USB specifications, USB standards, USB Layers and Linux USB subsystems, Topologies used in USB, OHCI, UHCI and EHCI type of USB controller ICs. Commands related to USB drivers, Registering the USB driver, USB Urbs, Practical USB device driver.

## **Module 21 USB Mouse Device Driver**

USB mouse specifications, 2 button and 3button mouse, scroll button architecture, PS2 and USB subsystems, USB wrapper driver programming on PS2 mouse programming, Inserting USB Mouse driver in running kernel, hot swapping architecture, Testing working of our driver with practical connection.

## **Module 22 USB Pen Drive Device Driver**

Pendriver Architecture, Flash memory commands, Storage architecture of data on Flash memory, Accessing and writing data on flash ICs, USB wrapper driver on MMC driver, Auto displaying drive name in file system, Practical Pen drive driver.

## **Module 23 Developing Network / Stream Device Drivers in Linux**

Comparison of char and Network driver, Driver Registration, net\_device structure, net\_device\_status structure, skbuff structure, network device methods, sample driver

## **Module 24 Embedded Linux based Project on Socket Programming**

## **Module 25 Embedded Linux based Project on Device Drivers**