Embedded System
Curriculum

ADVANCED C PROGRAMMING AND DATA STRUCTURE
(Duration: 25 hrs)

Introduction to 'C'
Objectives of C, Applications of C, Relational and logical operators, Bit wise operators, The assignment statement, Intermixing of data types, type conversion, cast Operator, Multiple assignment, Type definitions, Input/output
Routines, Formatted and unformatted I/O operations,
Single and multidimensional arrays.

Control Flow Statements In 'C'
If statement, else-if statement, While statement, for loop, do, while loop,
Switch, break and continue, go to

Functions
Definition of function and it's uses, Format of a function, Calling the function, C storage classes - extern, automatic variables, static variables, register variables Recursive functions, Macros.

Pointers
Introduction to pointers, The 'address of' and 'indirection' operators, Pointer expression, Data types of pointers, Pointers and arrays, Assignment of pointers, Pointer arithmetic. Comparison of two pointers,

Pointers and functions
Pointers and strings, String handling library functions, Additional string functions, Command line arguments.

Structures
Introduction to structures, Declaration and reference, Accessing structure elements, Array of structures, Nested structures, Self-referential structures.

Union & Enumerated Data Type
Introduction to Union, Dynamic memory allocation, Typedef statement. Enumerated data types Difference between use of structures and Unions, advantages and dis-advantages of union

Files
Introduction and need for a file, Library functions to open/close a file, Functions to read/write a single character from a file, Formatted input output functions used in file handling fscanf(), fprintf(), fgets(), fputs()

C Preprocessor
Macros with Arguments, Macro V/s Function, Preprocessor Directives, Conditional Directive, Miscleneous directives

Linked List, Stack and Queues
Introduction to linked lists, Concepts, definition and advantages of linked lists, Implementation of linked lists, Building and deleting nodes from linked lists.

Doubly Linked lists
Double sided linked list, Advantages, disadvantages and implementation of double sided linked list

Trees
Introduction and definition of trees, Arranging the tree, Binary tree structure, Building a binary tree, Addition and retrieval of node from binary tree, Traversing a binary tree, Inorder / Postorder /Preorder traversal.

8 BIT INTEL 8051 MICRO CONTROLLER
(Duration: 25 hrs)

Introduction To Embedded
Systems Use of 8051 microcontroller in embedded systems. Discussion on Micro Processor V/s. Micro controller, CISC V/s. RISC, Von Neumann V/s. Harvard Architectures, memory mapped I/O vs. I/O mapped I/O

Intel 8031/8051 Architecture
Pin Diagram details, Memory organization of 8051, Details of RAM, ROM, Timers, Peripheral Input/Output.

Introduction to Instruction Set
Instructions in details, byte-oriented instruction, bit-oriented instructions

Addressing modes of 8051
Immediate addressing mode, register addressing mode, direct addressing mode, register indirect addressing mode, indexed addressing mode, general purpose registers (GPRs) and special function registers(SFRs).

Description of pin –diagram
Accessing various general input-output ports.

Timers of 8051
Timer selection and control,
Timers registers, Timer modes, Timer configuration

Serial communication using 8051
Difference between simplex, half-duplex and full-duplex serial communication, Asynchronous and synchronous
serial communication,
Serial communication modes, register configuration

Interrupts in 8051
Writing ISR's in c and assembly, interrupt registers, interrupt vector table.

Basic communication protocols like UART, SPI,

I2C Interfacing of 8051 microcontroller
Seven-segment interface, led interface, lcd interface, adc interface, keypad interface, stepper motor interface.

Advantages of Cover Assembly
Importance of Assembly,
C and Embedded C, Discussion of Embedded software development

Introduction to Keil Uvision IDE 3
Program development on Keil using Assembly and Embedded C language, Example Programs.

8-BIT PIC MICRO CONTROLLER
(Duration: 25 hrs)

Difference between MP and MC, CISC v/s RISC
Definition of MP, MC, RISC, CISC, DSP, ES, RTOS
Introduction To RISC Architecture
I2O Lines, Peripherals, Timers
ADC, E2PROM, UART, PWM, I2C, SPI
Glue Logic Reset control, Brown out Detectors
Oscillators RC, LP, XT, HS
Watch Dog Timer and Pre-scalar

PIC Program/Software Development Tools For Embedded Control 3
PIC 16F877:
Detailed Treatment/ Description

General Description Of PIC16f877
PIC 16F8X Device Variation, Architectural Overview
Memory Organization, I/O Ports, Timer Modules, Data E2PROM Memory

Special Features of the CPU
Addressing Modes, Instruction Format, Instruction set summary
I2C, Watch dog timers and some advanced features of PIC 16F877

7-segment look up tables, ASCII to HEX/HEX to ASCII conversion
8/16 bit BCD to Binary, 8/16 bit Binary to BCD, 4 -digit BCD
UP/DOWN counter

Logic Oriented Programs (MPLAB)
Introduction to MPLAB IDE, usage of simulator, debugger, logic analyser etc
Temperature control, Stepper motor/DC motor, LCD modules, keypad interface, I2C interface

32-BIT ARM MICROCONTROLLER
(DURATION: 15 Hrs)

Introduction to the ARM architecture
About the ARM architecture, architecture, Registers, Current Program Status Register (CPSR),Stored Program Status Register(SPSR),what is Pipelining, various Exception modes in ARM,ARM processor mode
Introduction to Instruction Set
Types of instruction set:
ARM instruction set, THUMB instruction set, categories of instructions, branching instructions, data-processing instructions, load-store instructions etc.
Introduction to Philips LPC2129
General description, features, application, block diagram, memory organization, pin configuration
GPIO- General Peripheral input/output
Features, application, pin description, register description

UART0
Features, application, pin description, register description
UART1
Features, application, pin description, register description
I2C
Features, application, pin description, register description
TIMER0 and TIMER1
Features, application, pin description, description
AD Converter
Features, application, pin description, register description
WATCHDOG
Features, application, pin description, register description
Philips ISP utility
In application programming
ARM Program/Software Development Tools
Introduction to Keil IDE, using the Keil toolset, using the Debugger, Simulator
Interfacing Programs
Led interface, LCD interface, Stepper motor interface, Seven segment interface

Project on 8051 / PIC Microcontroller
LINUX INTERNALS
(Duration: 25 hrs)

MULTI PROCESSING
What Is a Process?
Process Structure
The Process Table
Viewing Processes
System Processes
Process Scheduling
Starting New Processes
Replacing a Process Image
Duplicating a Process Image
Zombie Processes
Input and Output Redirection

SIGNALS
Signal Handling
Sending Signals
An Alarm Clock

MULTI THREADING
What Is a Thread?
Advantages and Drawbacks of Threads
Simultaneous Execution
Simultaneous Execution of Two Threads

IPC (INTER PROCESS COMMUNICATION)
IPC USING PIPES
Process Pipes
popen
pclose
Reading Output from an External Program
Sending Output to popen
Sending Output to an External Program
The pipe Function
Named Pipes: FIFO
Creating a Named Pipe
Accessing a FIFO File
Opening a FIFO with open
Opening FIFO
Inter-Process Communication with FIFO

SEMAPHORE, SHARED MEMORY AND MESSAGE QUEUE SEMAPHORE
Semaphore Definition

A Theoretical Example
Linux Semaphore
Facilities
semget
semop
semctl

SHARED MEMORY
shmget
shmat
shmdt
shmctl

MESSAGE QUEUE
msgget
msgsnd
msgrcv
msgctl

SOCKET PROGRAMMING
What Is a Socket?
Socket Connections
Socket Attributes
Socket Domains
Socket Types
Socket Protocols
Creating a Socket
Socket Addresses
Naming a Socket
Creating a Socket Queue
Accepting Connections
Requesting Connections
Closing a Socket
Socket Communications

SOCKET PROGRAMMING USING AF_UNIX:-
Local Client
Local Server

SOCKET PROGRAMMING USING AF_INIT:-
Network Client
Network Server

LINUX DEVICE DRIVER
(25 Hrs.)

INTRODUCTION
HARDWARE BASICS
The CPU, Memory, Buses, Controllers and Peripherals, Addresses, Timers, Intro to kernel
Directory structure of Linux OS.
Kernel Source Code
Configuring & compiling the kernel

ROLE OF DEVICE DRIVER
Types of Device driver
Loadable modules and its benefits
Functions used to load and unload modules
Passing parameters to a loadable module

WRITING A DEVICE DRIVER PROGRAM
Important Header Files
Writing a simple module
Compiling and loading modules
Device information in /proc

CHARACTER DRIVER
Character driver basics
Major and minor numbers
Creating device files with mknod
Registering a character device driver

ADVANCE CHARACTER DRIVER IOCTL
commands to interact with a device
Implementing IOCTL in driver
Functions for accessing user and kernel space

KERNEL TIMERS
Jiffies counter Time space counter (TSC Counter)
Measuring Time Lapses Knowing the Current
Time Delaying Execution

MEMORY MANAGEMENT
Memory Mapping and DMA
Memory Management in Linux
The mmap Device Operation Performing Direct I/O
Direct Memory Access
Memory allocation with kmalloc and kfree
Page oriented memory allocation

Memory allocation in the virtual address space
Platform dependency issues

COMMUNICATION WITH PARALLEL PORT I/O
Ports and I/O Memory regions.
Communication Using I/O Ports
Communication Using I/O Memory

INTERRUPT HANDLING
Preparing the Parallel Port
Installing an Interrupt Handler
Implementing a Handler

Project Work on Linux Device Driver
RTOS 10 Hrs

INTRODUCTION
What is Real Time System?
Requirements of Real time
System Hard Real-time Systems Soft Real-time Systems
What is a task creation?
Unitask approach Vs multitask approach
Task states
Multitasking Kernel
Context switch
Priority based scheduling
Round Robin scheduling
Task states in details suspend, delay, pended
Task hooks

Task State Transition
Wind Task Scheduling
Preemptive Priority Scheduling
Round-Robin Scheduling
Preemption Locks
A Comparison of task Lock( ) and int Lock( )
Task Control
Task Creation and Activation
Task Stack Task

Names and IDs
Task Options
Task Information
Task Deletion and Deletion Safety
Task Control
Multiple Tasks with the Same Main Routine

Interties Communications
Shared Data Structures
Mutual Exclusion
Preemptive Locks and Latency
Semaphores Semaphore
Control
Binary Semaphores
Mutual-Exclusion Semaphores
Counting Semaphores
Special Semaphore Options
Semaphores and VxWorks Events
Message Queues
Wind Message Queues
Displaying Message Queue Attributes
Message Queues and VxWorks Events
Pipes

Signals
Basic Signal Routines
Signal Configuration
VxWorks Events
Sending and Receiving Events
Waiting for Events
Registering for Events
Freeing Resources
Watchdog Timers