SECTION I : Embedded System Fundamentals

- **Module 1: Embedded System Basics**
  This module covers the basics of embedded system. It covers various embedded domains.
  - What is embedded system
  - Various examples and their designs discussed
  - Hardware needs(Microprocessor and Micro controller
  - OS based and non OS based Embedded System
  - Development environment(IDE,cross compilers,debugger toolchains)
  - Development setups
  - What is BSP
- **MODULE 2**: Embedded **C overview**
  This module revises C for the system programming. Topics are:
  - Pointers
  - Function pointers
  - Structures union ,bitfields
  - Bitwise operators
  - Hardware instructions in C
  - DataStructures – Linked list, queues, stacks
  - Static /shared Libraries
  - Makefiles

- **Module 3: ARM Microcontroller Programming**
  This module is focused on architecture and programming on ARM microcontroller.
  - Microcontroller fundamentals
    - Architectural overview
    - Registers
    - Instruction set
  - Programming
    - Peripherals devices and programming
    - Development setup with Keil
    - Various programming examples

PIC controller and 8051 Microcontroller are optional modules which students can opt for.

SECTION II : Operating System Programming

- **MODULE 4: Operating System Concepts and Programming**
  This module aims to introduce the Operating system concepts and focuses on programming in User Space . This module provides strong foundation to student and emphasises programming in Linux OS . Main Topics are :

  - Creating Processes

- Threads and multithreading
- Semaphores, Mutex
- IPC mechanism Pipes, Shared memory etc.
- Sockets and client server programming

- **Module 5 :Kernel Module Programming**
  This module introduces the Operating System Kernel programming. It gives basic aspects of working in Kernel and makes comfortable in kernel programming. All the topics in this module are Completely practical oriented . They are :

  - Compiling kernel
  - Static linking ,dynamic linking of modules
  - User space ,kernel space concepts
  - System calls
  - Writing simple modules
  - Writing Makefiles for modules
  - Proc filesystem
  - Debugging modules

- **Module 6: Character Device driver Development**
  This module aims to provide understanding of device structures and programming aspects For devices. It provides practicals on various drivers modules. Some of the topics are:

  - Driver concepts
    - Block & character driver distinction
    - Low level drivers, OS drivers etc
  - Writing character drivers
    - Device major,minor number
    - Interfaces to driver read,write,ioctl etc
    - Blocking and non blocking calls
  - Synchronisation
    - Semaphores , mutexes ,spinlocks
  - Proc & Sysfs interfaces
  - Interrupt Handling
    - Interrupts and bottom halves
    - Writing interrupt driven drivers
    - Implementing bottom halves
  - Kernel Threads & Work Queues
  - Timers
    - Kernel timers
    - Jiffies , Timer interrupts
  - Kernel linked list implementation
  - Interfacing with hardware
    - IOMapped IO

- Memory mapped IO

Understanding DMA ops

SECTION III : Embedded Linux & ARM

- **Module 7: Embedded Linux Architecture** -
  - Kernel considerations
  - Boot loaders and boot configurations
  - Filesystem considerations and solid state medias
  - Various hardware processors in embedded arena

- **Module 8 :Introduction to ARM architecture**
  - Various ARM processors and revision
  - ARM programming modes
  - Register sets and instructions
  - Hosting OS on ARM

- **Module 9:Porting Linux on ARM**
  - Tool chains
  - Choosing kernel configuration
  - Cross compilation
  - Building RootFS
  - Booting Linux & start up

- **Module 10 :Programming on ARM Linux**
  - Application programming on ARM linux
  - Interfacing with hardware/GPIO
  - Writing small drivers on ARM

- **Module 11 :Debugging**
- **Module 12 :Basics of Real Time Linux Considerations**
  - RTOS concepts
  - Real Time Linux
  - Typical applications of Real Time

Note : Section III needs knowledge of section II. Student can opt only Section I or only II or II&III.