

# **NSF CCLI Project: Collaborative Development of a Microcontroller Training System for Two and Four Year Distance Learning Engineering Students**

## **Curriculum Design**

### **Course Curricula Session Topics and Contents**

#### **Session #0: Microcontroller Technology**

**Course Content:** A Brief History of Microprocessor Development, Differences between Microcontrollers and Microprocessors, Microcontroller Applications, Microprocessor Architectures, Memory Types, Microcontroller Packaging/Appearance, PIC16F84A, PIC16F88, and PIC16F877A Memories

**Lab #0:** Download Related Software and Familiar with PIC Training System Hardware

#### **Session #1: Gates, Number Systems & PIC Environment**

**Course Content:** Different Number Systems, Number System Conversions, Logic Gates, Logic Arithmetic (Add & Subtract), Header File and Source Codes, The Environment and Software Operations, Header File and Source Codes

**Lab #1:** MPLAB Simulation, PICKIT2 Programming, Header File Creation, PIC Training System Operations

#### **Session #2: PIC Instructions in Assembly Language Programming**

**Course Content:** Assemble Language Format, PIC Instruction Sets & Registers, 16F84A, 16F88, & 16F877A Internal Blocks and DRAM Distributions, C, Z, and DC Flags in STATUS Register, Setting and Clearing bits, Logic & Math Operations, Addressing Modes

**Lab #2:** Assembly Code Writing, Math and Logic Operations, Addressing Modes, Program Simulation and Execution

#### **Session #3: I/O Interface**

**Course Content:** PIC Embedded System Designs, Use of Internal Oscillator and External Resonator, Ports Configuration, I/O Port Interface, DIP Switches Inputs, LED Controls, 7-Segment Interface

**Lab #3:** Logic Inputs from a DIP switch and Outputs to LEDs Indication and 7 Segment Controls

## **Session #4: Assembly Language Software Designs**

**Course Content:** Flowcharts, Programming & Controls, Counters, Loops, Time Delays, Subroutines, DRAM Memory Banks, PRAM Memory Pages

**Lab #4:** Programming Loops Designs, Time Delay on LEDs Activations, Subroutine Implementations

## **Session #5: The Uses of WDT**

**Course Content:** CONFIG Register Configuration, Watch Dog Configuration, WDT Controls & Applications

**Lab #5:** WDT Controls and Demonstrations

## **Session #6: The Uses of IRQs**

**Course Content:** Source of Interrupts, Flags and Enable Setup, Interrupts Handler, IRQ Configuration, Polling vs. IRQ, IRQ Service Routines, Prioritize IRQ Services, Multitask Applications

**Lab #6:** IRQs on RB0 Controls and Demonstrations

## **Session #7: Parallel Data Communication**

**Course Content:** Parallel Interface, Data Transmission Protocol, Long and Short Table Lookup Implementations, LCD Module Interface

**Lab #7:** LCD Module Display with Different Look up Table Implementations

## **Session #8: 3\*4 or 4\*4 Matrix Keypad Interface Designs**

**Course Content:** Software Debounce Designs, Keys' Decoding Design, Matrix Keypad Interface Designs, Interface Software Design, Testing and Verification

**Lab #8:** Matrix Keypad, Scanning, Debouncing, and Decoding Exercises

## **Session #9: Stepper Motors Controls**

**Course Content:** Uni-polar & Bipolar Stepper Motors, Stepper Motors Interface, H-Bridge, Driver, Speed, and Direction Designs/Controls

**Lab #9:** Controls of two Stepper Motors Exercises

## **Session #10: DC Motors Controls**

**Course Content:** H Bridges Controls, DC Motors Interface, Driver, Speed, and

**Lab #10:**

Direction Designs/Controls, PWM Controls  
Controls of two DC Motors Exercises