NSF TUES DUE Type 2 Project:
Dissemination of Microprocessor Courses through Classroom and Interactive Cyber-Enabled Technologies
Award ID: 1120000

Course Curricula and Lab Modules Topics and Contents

Course Module #1: Microcontroller Technology

A history of microprocessor development, differences between microcontrollers and microprocessors, microcontroller applications, microprocessor architectures, memory types, microcontroller packaging/appearance, PIC16F84A, PIC16F88, and PIC16F877A memories

Lab Module #1:

Download operation software and become familiarized with the PIC training system hardware

Course Module #2: Numbers and Programming Languages

Number systems, number system conversions, logic gates, logic math (addition & subtraction), assembly language format, the environment and software operations, header files, and source code

Lab Module #2:

MPLAB simulation, PICKIT2 programming, header file creation, PIC training system operations

Course Module #3: Register and Memory Programming

PIC instruction sets & registers, 16F84A, 16F88, & 16F877A internal blocks and data memory (DM) distributions, DM blocks and program memory (PM) page controls, C, Z, and DC flags in the STATUS registers, setting and clearing bits, logic & math operations, and addressing modes.

Lab Module #3:

Assembly code writing, math and logic operations, addressing modes, program simulation and execution

Course Module #4: I/O and Routines

PIC embedded system design, use of internal oscillators and external resonators, port configuration, I/O port interfacing, DIP switch inputs, LED controls, 7-segment interfacing, flowcharts, programming & controls, counters, loops, time delays, subroutines, DM memory banks, PM pages.

Lab Module #4:

Logic inputs from a DIP switch and outputs to LEDs, 7 segment display controls, programming loop design, time delay on LEDs activations, subroutines.

Course Module #5: I/O and Watch Dog Applications

CONFIG register configuration, Watch Dog Configuration, WDT controls & applications, the WDT in low power hibernation.

Lab Module #5:

WDT controls and demonstrations

Course Module #6: Interrupts

Sources of interrupts, flags and enable setup, interrupt handler, IRQ configuration, polling vs. IRQ, IRQ service routines, prioritization of IRQ services, multitasking applications, ISR implementations.

Lab Module #6:

IRQs on RB0 or RB4-RB7 controls and demonstrations

Course Module #7: LCD Communications

Parallel interfaces, data transmission protocols, long and short table lookup implementations, LCD module interface.

Lab Module #7:

LCD module display with different lookup tables

Course Module #8: Keypad Controls

Software debounce designs, key decoding designs, matrix keypad interface design, Software interface design, testing and verification.

Lab Module #8:

Matrix keypad, scanning, debouncing, and decoding exercises

Course Module #9: Stepper Motors Controls

Uni-polar & bipolar stepper motors, stepper motor interfacing, H-bridge: driver, speed, and direction designs/controls.

Lab Module #9:

Controls of a stepper motor's speed and direction

Course Module #10: DC Motors Controls

H-bridge controls, DC motors interface, driver, speed, and direction designs/controls, PWM controls.

Lab Module #10:

Control of two DC Motors' speeds and directions

Course Module #11: ADC and DAC Controls

Analog to digital and digital to analog conversion, scaling, and communication with the LCD

Lab Module #11:

Collecting analog data, data processing, analog to digital, and digital to analog

Course Module #12: Remote Data Logging

2.4 GHz radio frequency data logger, RF transceiver through serial peripheral interface (SPI) Bus

Lab Module #12:

RF data logger Exercise with 2.4 GHz MRF24J40MA transceiver

Course Module #13: Wave Forms Generation

Design a waveform generator which outputs sinusoid, square, and triangle forms

Lab Module #13:

Waveform generation with the PIC trainer

Course Module #14: Parallel Control of DC Motors

PWM control of DC motors, monitoring the state of the motor, changing the DC motor output

Lab Module #14:

PWM control of a DC motor, altering motor speeds, altering the duty cycle of the PWM module

Course Module #15: Feedback Loops with RF Sensing and DC Motors

Use multiple built-in microcontroller functions, A/D conversion and PWM with interrupt, control DC motors, RF sensing, controlling the speed of DC motors

Lab Module #15:

Hardware and software implementation of the ADC, PWM interrupt functions to control multiple DC motors through RF sensing

Course Module #16: Multi-Processors with SPI Protocols

Multi-processor communications with SPI protocol designs

Lab Module #16:

Communicate data from one processor to the other