Possible Structure for an Introductory Course in Embedded Systems/Microcontrollers,

using PIC 16 Series Microcontrollers and Assembler Programming

making use of the book

***Designing Embedded Systems with PIC Microcontrollers – Principles & Applications*, by Tim Wilmshurst**

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Notes:
1. This schedule assumes students have some knowledge of digital electronics. If not, certain topics will need to be introduced in parallel.
2. The 16F84A is used initially as it illustrates entry level microcontroller structure. This is a direct subset of the larger, 16F87XA, so students directly transfer *all* knowledge to the larger device as they move on. However the 16F87XA can be used from the start if desired.
3. Encourage students to download their own copy of MPLAB for free, and run on their home computer

Lecture	Topic	Book Pages	Comment	Programming examples/ exercises
1	**Tiny Computers, Hidden Control – an Introduction to Embedded Systems and Microcontrollers:** Embedded system and key computer concepts. The microcontroller, structure as core + peripherals + memory	Ch 1, pp 3-17 (or 20)	This needs to be tailored to meet the current level of knowledge of student group.	-
2	**Introduction to the PIC 16 Series Microcontroller**: 16F84A structure, ALU & Status register, Buses, program and data memory maps, peripherals.	Ch.2 pp 25-44 (or subset)	Forward reference can if wanted be made to the wider 16 Series family, and the 16F87XA structure.	-
3	**Digital Input/Output**: Concept of memory-mapped SFRs, the PORT and TRIS registers. Interfacing with switches and leds.	Ch. 3, pp 45-58	The internal logic diagrams of the port driver circuits, e.g. Figs 3.3, 3.10 are interesting/ accessible to students of electronics, much less so for others. In this case, treat them with a light touch!	-
4	**Introductory Assembler Programming**: assembler format, the 16 Series instruction set. Use of MPLAB and MPSIM, an introductory data transfer program.	Ch. 4, pp 65-83	It helps to learn MPLAB and MPSIM as early as possible.	MPLAB tutorial, pp 77-84

5	**Writing Simple Programs**: Use of flow diagrams, conditional branching and working with bits. Subroutines, writing time delays.	Ch. 5, pp 89-96		Programming Exercise 5.1, p. 94.
6	**Further Programming**: Using arithmetic and logical instructions. Breakpoints and Stopwatch in MPSIM	Ch. 5, pp 101-104, 109-112		Programming Exercises 5.3, p. 104 and 5.8, p. 112. Pingpong simulation p. 116.
7	**Building a Complete Circuit:** hardware essentials: power supply, oscillator and reset. An example minimum system, the electronic pingpong.	Ch. 3, pp 59-64. App. 2, p 528		-
8	**Interrupts**: interrupt concepts and structures, the CPU response to interrupts, the 16F84A structure. Writing simple interrupt-based programs.	Ch 6, pp 120-126		Simulation Exercise 6.1, p.126,
9	**The Timer/Counter**: Concepts of digital counting, the Timer 0 module, interrupt on overflow. Use as counter and timer.	Ch 6, pp 131-138		Simulation Exercise 6.4 & 6.5, pp 137, 138
10	**Moving to Larger Microcontrollers, the 16F87XA:** The 16F87XA group of microcontrollers, their peripheral set, memory maps and interrupt structure.	Ch 7, pp 145-154		-
11	**Keypads and Displays:** Keypad structure, interconnection and driving routines. 7-segment led characters, common anode/ cathode connection and multiplexed driving. PIC-based drive routines.	Ch 8, pp 184-198		Program Example 8.2, p.197
12	**Expansion Time.**			