

CMPEN 473
Microcomputer Laboratory
Spring Semester 2007
Technical Elective in Computer Engineering and Computer Science

Catalog Data: Microcomputer Laboratory (3)
Design of digital systems using microprocessors. Prerequisite: CMPEN 472.

Typical Textbook: *Embedded Microcomputer Systems: Real Time Interfacing*, 2nd Edition, Jonathan W. Valvano, Thomson, 2007. Optional.

Numerous class handouts and web based information.

Course Objectives: This laboratory provides senior students with both theory and practice in designing, implementing, and debugging microprocessor-based systems.

Primary Course Outcomes: Upon completion of the course, students should possess the following skills:

- Be able to work in a standard digital laboratory and use standard digital testing equipment.
- Be able to take a problem statement and implement a solution using a combination of hardware and software while using a microprocessor/microcontroller.
- Be able to design the hardware subsystems of a microprocessor/microcontroller system.
- Be able to program a microprocessor/microcontroller to operate in a control/sensing environment.
- Be able to interface various devices to a microprocessor/microcontroller, including memory.
- Be able to write effective technical reports.
- Be able to work effectively as a member of a team of designers.

Relationship to Undergraduate Program Outcomes: CMPEN 473 is a lab course which reinforces and expands on elements learned in CMPEN 472 and which supports the following program outcomes:

- Demonstrate basic laboratory skills, including the use of standard laboratory equipment.
- Analyze and design circuits, devices and systems using differential and integral calculus and principles of electricity, magnetism, and modern physics.
- Design the electronic/logic circuits that form the basic building blocks of a computer system.
- Design the architecture and organization of the basic components of a computer system.
- Analyze algorithms or computer code for correctness and efficiency.
- Write clear and effective technical prose.
- Demonstrate independent learning by using unfamiliar computer systems, test equipment and software tools to solve technical problems.
- Be able to discuss major trends in industry and current research activities within the discipline.
- Demonstrate an ability to work effectively in multi-disciplinary teams. The term multi-disciplinary is used here in the broader sense to include teams of computer professionals having different skills; e.g., one team member might be familiar with web development, whereas another might have experience with microprocessor systems.

- Required Topics:** Basic laboratory procedures and equipment. Debug techniques and basic CPU implementation (6 hours)
Address decoding and memory bus interfacing, timing and analysis. Adding external memory to a microcontroller. (6 hours)
LCD displays, keypads and additional interfacing to the CPU bus. (6 hours)
LED's, interfacing using a standard I/O port. (6 hours)
Interrupts, interrupt handling, background operations. (6 hours)
D/A conversion, audio signal generation, amplification techniques, filtering. (6 hours)
A/D conversion. (3 hours)
Control theory, classical and fuzzy. (4 hours)
- Class Format:** Lecturing is front loaded in the course (3 hours/week) and tapers off as the semester progresses. The laboratory is open 24/7 with students working according to their own schedule in order to complete required assignments on time.
- Professional Component:** CMPEN 473 gives students practical laboratory design experience with microprocessor/microcontroller systems – their design and application. The course centers on 7 projects which build on each other such that at the end of the semester students will have built the hardware and software of a complete single board microcontroller system. Students work in teams of 2-3 students on all projects.
- Students have access to standard test equipment (e.g. oscilloscope and logic analyzers) and PCs in the laboratory. They are exposed to a variety of software including schematic capture software, PLD design and programming software, and microprocessor development tools.
- Evaluation:** Students are graded equally on the 7 assigned projects. Points are awarded for i) completing the basic project, documentation, and bonus elements added to the project. Project grades make up 80% of the course grade. The remaining 20% is awarded from two mid-term exams, which are individually scored and graded. Each student must have an average exam score of at least 60% in order to pass the course, regardless of project scores.

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