1. **Department, number and title of course:** Computer Science: CS 152, Computer Architecture and Engineering

2. **Catalog Description:** (5 units) Instruction set design, Register Transfer. Verilog and CAD tool design. Testing methodologies. Data-path design. Controller design. Memory system. Addressing. Microprogramming. Computer arithmetic. Out-of-order pipelining and branch prediction. Survey of real computers and microprocessors. Computer design project requiring about 100 hours involves creative application of techniques to build unique pipeline.

3. **Prerequisites:** CS 150.

4. **Textbooks and/or other required material:**

5. **Course objectives:** This course will give you an in-depth understanding of the inner-workings of modern digital computer systems and tradeoffs present at the hardware-software interface. You will work in groups of 4 or 5 to get an understanding of the design process in the context of a complex hardware system and practical experience with computer-aided design tools. You will be required to present your design and results in front of the TAs and class.

6. **Topics covered:**
   - 5 components of a computer
   - ISA's and Intro to MIPS
   - MIPS operations and Performance
   - Delay Modeling
   - Low Power Design
   - Design Process, ALU & Adders
   - Multipliers & Shifters
   - Dividers & Floating Point
   - Verilog
   - Design and testing methodologies
   - Single cycle datapath and control
   - Multiple cycle processor, controller, and microprogramming
   - Exceptions
   - Introduction to Pipelining
   - Pipelining and control
   - Pipelining and exceptions
   - Advanced pipelining, Out-of-Order Execution, Branch Prediction.
   - Intro to Memory Systems
   - Cache Design
   - Virtual memory
   - I/O Systems
   - Embedded Processors
   - DSP processors
   - Real world processor design with examples of impact of technology

7. **Class/laboratory schedule:** Three hours of lecture and one hour of discussion per week and one large design project.
8. **Contribution of course meeting the professional component:** This class contributes to engineering topics. It is approximately 60% science and 40% design. It provides a capstone design experience.

9. **Relationship of course to program objectives:** This course requires students to apply their fundamental knowledge of mathematics, science, and engineering to analyze and solve engineering problems. Working in teams of 2 or 3, they identify, formulate, and solve challenging engineering problems using modern skills, techniques, and engineering tools. Their final design project is open ended and requires application of skill and techniques to produce a unique result.

10. **Prepared by:** Professor John Kubiatowicz, April 4, 2006.