

## **Proposed Syllabus for TCSS 372 Computer Architecture (Autumn 2009)**

### **Catalog Description:**

#### **TCSS 372 Computer Architecture (5)**

Covers the micro architecture level of machine design and advanced architecture features for performance enhancement. Subjects include I/O, bus, memory and CPU design, hardware support for operating systems, CISC/RISC architectures, and parallelism.

Prerequisites: a minimum grade of 2.0 in both TCSS 371 and TCSS 342.

### **Educational Objectives:**

This course builds on the material from TCSS 371 and:

- teaches students how modern computer hardware supports the design of operating systems,
- shows how the hardware can be customized to improve system performance,
- explains the differences between RISC and CISC processors,
- describes how the internal operations of a computer are controlled, and
- explains how peripheral devices communicate with a processor.

### **Educational Outcomes:**

Upon successful completion of this course a student should be able to:

- explain how a processor responds to a requests for an interrupt,
- describe how the processor communicates with and controls peripheral devices,
- explain how physical memory is organized and how cache memory enhances memory performance,
- describe the primary differences between RISC and CISC architectures and instruction sets,
- explain how microprogram control units and hard-wired control units operate,
- create a new or modify an existing instruction within a processor,
- describe how parallelism is achieved within a processor,
- describe how a computer performs arithmetic operations, and
- explain how a processors architecture supports multitasking.

### **Topics covered (not necessarily in the order given)**

1. Advanced organization
  - a. Busses and bus timing
  - b. Memory hierarchy
    - i. register file
    - ii. cache memory (design and operations)
    - iii. main memory
    - iv. external store
  - c. I/O
    - i. devices
    - ii. access (memory mapped vs. special I/O instructions) and drivers
    - iii. DMA
2. Operating Systems Support/Overview

- a. Multitasking/threading
  - b. Scheduling
  - c. Memory management and virtual memory
  - d. File systems
3. Computer arithmetic
  - a. algorithms for integer multiplication and division, ALU designs
  - b. Floating point representation and arithmetic
4. Advanced Instruction Set Architectures
  - a. Instruction formats
  - b. Data types
  - c. Addressing modes
5. CISC/RISC Architectures
  - a. Comparative CPU organizations
  - b. Pipeline designs and operations
  - c. Compiler issues
6. Advanced Architectures
  - a. Instruction-level Parallelism
  - b. IA-64 Architecture
  - c. Superscalar architecture
  - d. Branch prediction
  - e. Prefetching
  - f. Speculative execution
  - g. Multithreading
  - h. Scalability
7. Control Unit and Microarchitecture
  - a. Micro-operations
  - b. Processor control
  - c. Hardwired implementations
  - d. Microprogramming
8. Parallel Organization
  - a. Multiprocessors, multiple cores (shared memory systems)
  - b. Introduction to SIMD, MIMD
  - c. Cache coherence