CSC 565 - COMPUTER ARCHITECTURE AND PARALLEL PROCESSING

CREDIT HOURS: 3
PREREQUISITES: Nine advanced hours of CSC (CSC 214 is recommended)
GRADE REMINDER: Must have a grade of C or better in each prerequisite course.

CATALOG DESCRIPTION

Organizational and operational analysis of digital computers at the component and functional levels. Design and performance issues. Algorithms and architectures for parallel processors.

PURPOSE OF COURSE

To study the structural and functional organization of computers and to understand the design issues and tradeoffs for Von Neumann and parallel processing architectures.

EDUCATIONAL OBJECTIVES

The goal of this course is to have students develop the concepts and skills required to evaluate new computer design approaches and parallel processing techniques. Student evaluation will be based on successful completion of progressively more advanced laboratory problems, performance on homework assignments, and analysis of test responses. Specific skills include:

1. Demonstrate knowledge of the issues and problems in computer architecture.
2. Develop skills in analysis and design of new architectures based on existing and proposed systems.
3. Relate design and analysis techniques to application performance requirements.
4. Explore performance enhancement issues including superscalar, superpipelined designs, caching techniques, multiple computational units, and I/O subsystems strategies.
5. Apply analysis of component interaction to performance.
6. Develop knowledge of parallel algorithms, techniques, and tools.
7. Enhance problem solving through parallel algorithm development and analysis.

CONTENT — Hours

Overview of Machine Levels (Historical and Contemporary) 2
- Design trends and issues (RISC vs CISC, future)

Computer Systems Organization 7
- Processors, memory, I/O, classification, technology
- Paradigms and Models

Performance 3
- Metrics and Benchmarks
- Speedup and Scalability

Pipelining and Vector Processing 3
- Principles, classification, reservation tables, buffers, prefetching, forwarding, hazards

Superscalar Processing 3
Functional structures, processes, tasks, threads, interconnection networks and buses, parallel memory, concurrency

Parallel Algorithms 9
Concepts, Terminology, Issues
Processes, Threading, Timing

Parallel Algorithm Design 9
Models, Partition, Communication, Mapping
MPI and OpenMP

Parallel Algorithms Examples and Implementation 3
Graphs, Matrices, Numeric and Non-numeric
MPI and OpenMP

Advanced Architectures 3
Data Flow, GRID, Biological, Optical
Example systems

Exams (plus final) 3

TOTAL 45

REFERENCES

Flynn, M., Computer Architecture, Jones and Bartlett, 1995.

Hennessy, J., and Patterson, D., Computer Architecture A Quantitative Approach, 4th Ed., 2007.

Hwang, K and Z. Xu, Scalable Parallel Computing, McGraw-Hill, 1998.

Quinn, M. J., Parallel Programming in C with MPI and OpenMP, McGraw-Hill, 2004.

Shiva, S. G., Advanced Computer Architectures, CRC Press (Taylor and Francis), 2006.

Tanenbaum, A. S. Structured Computer Organization, 5th Ed., Prentice Hall, 2006.

Vahid, F., and T. Givargis, Embedded System Design, Wiley, 2002.