NORTH CAROLINA STATE UNIVERSITY

GRADUATE COURSE ACTION FORM

NOTE: Click once on shaded fields to type data. To check boxes, right click at box, click “Properties”, and click “Checked” under Default Values.

DEPARTMENT/PROGRAM: Electrical and Computer Engineering

COURSE PREFIX/NUMBER: ECE 785

DATE OF LAST ACTION:

COURSE TITLE: Advanced Computer Design

ABBREVIATED TITLE: ADVANCED COMP DESIGN

SCHEDULING: Fall ☒ Spring ☐ Summer ☐ Every Year ☒ Alt. Year Odd ☐ Alt. Year Even ☐ Other ☐

COURSE OFFERED: BY DISTANCE EDUCATION ONLY ☐ ON CAMPUS ONLY ☒ BOTH ON CAMPUS AND BY DISTANCE EDUCATION ☐

CREDIT HOURS: 3

CONTACT HOURS: Lecture/Recitation 3 Seminar ☐ Laboratory ☐ Problem ☐ Studio ☐ Independent Study/Research ☐ Internship/Practicum/Field Work ☐

GRADING: ABCDF ☒ S/U ☐

INSTRUCTOR (NAME/RANK): Gregory T. Byrd, Associate Professor

Graduate Faculty Status: Associate ☐ Full ☒

ANTICIPATED ENROLLMENT:

Per semester 20 Max. per Section 20 Multiple sections Yes ☐ No ☒

PREREQUISITE(S): ECE 520, ECE 521

COREQUISITE(S):

PRE/Corequisite for:

RESTRICTIVE STATEMENT:

CURRICULA/MINORS:

Required ☐ Qualified Elective ☐

PROPOSED EFFECTIVE DATE: Fall 2006

CATALOG DESCRIPTION: In depth study of topics in computer design; advantages and disadvantages of various designs and design methodologies; technology shifts, trends, and constraints; hardware/software tradeoffs and co-design methodologies

RECOMMENDED BY:

Department Head/Director of Graduate Programs ☐ Date

ENDORSED BY:

Chair, College Graduate Studies Committee ☐ Date

College Dean(s) ☐ Date

APPROVED:

Dean of the Graduate School ☒ Date
Course Justification
The design of computer systems requires advanced knowledge in a broad range of areas within computer engineering. While the computer engineering curriculum provides both breadth and depth in key fundamental areas – such as computer architecture, software, VLSI, and networking – there is a need for a course in which specialized sub-topics, and combinations of sub-topics, can be covered in depth at an advanced level.

The sub-topic for each offering of ECE 785 will be chosen by the instructor. The sub-topic will build on the core computer engineering classes, ECE 520 (ASIC design) and ECE 521 (microarchitecture), and will require an understanding of processor architecture, memory hierarchies, and VLSI design. It will also be distinct from existing advanced computer engineering courses. Examples of possible sub-topics include: interconnection networks, network-on-a-chip (NOC) and system-on-a-chip (SOC) design methodologies, and hardware support for computer and network security. Sub-topics that are strictly contained within computer architecture are more appropriate for ECE 786, Advanced Topics in Computer Architecture; sub-topics chosen for ECE 785 will have a broader scope and will contain a significant VLSI component.

The attached syllabus uses interconnection networks as its sub-topic. In any multiprocessor system, interconnection networks are used to communicate between parallel components. Students encounter these networks many times in their courses, but they do not typically examine their design tradeoffs in detail. This course will use seminal and recent research literature to explore topics such as topology, switching protocols, routing protocols, physical layout, and network-processor interfaces.

Based on the number of active faculty and their students, and enrollment in other advanced computer architecture courses, we anticipate enrollment of approximately 25-30 consistently per year.

Student Learning Objectives
- See syllabus

Previous Enrollment
This course was offered as ECE792C Fall 2005 and had an enrollment of 16 students

New Resources
No new resources are required for offering this course.

Consultation with Other Departments
Computer Science was consulted and has no objections to the course being added.
ECE 785: Advanced Topics in Computer Design  
Interconnection Networks  
NC State University  
Fall 2005

Course Syllabus

<table>
<thead>
<tr>
<th>INSTRUCTOR</th>
<th>OFFICE HRS</th>
</tr>
</thead>
</table>
| Dr. Greg Byrd (gbyrd@ncsu.edu)  
Assoc. Professor, ECE Dept.  
Partners I, Suite 2300  
(919) 513-2508 | MW 1:00-2:00, Partners I  
TH after class, as needed |
| TBD | TBD |

Course Overview

This course addresses advanced topics in the design and implementation of interconnection networks, especially those used for multiprocessors, clusters, and single-chip parallel systems. The course material will primarily be recent and “classic” papers from the research literature, covering material that represents the current state of research. A representative sample of topics for the course includes:

- interconnection network topologies
- switching and routing protocols, including adaptive routing
- network-processor interfaces
- state-of-the-art network implementations (e.g., Myrinet, Infiniband, optical networks)

Prerequisites

The prerequisites for this class are ECE 520 and ECE 521. If you have not had these classes, or an equivalent class at another institution, see me immediately. You will need a working knowledge of instruction set architecture, pipelining, memory hierarchies, and VLSI system design before taking this class.

Learning Objectives

Upon completion of this course, a student will be able to:

- describe a variety of network topologies and their characteristic metrics;
- describe packet-level switching and routing protocols used in interconnection networks;
- describe the design of switching components and processor interfaces for high-performance interconnection networks;
- discuss the tradeoffs between latency, bandwidth, and implementation cost;
- discuss the performance, cost, and reliability of various interconnection network implementations;
- predict technology shifts, trends, and constraints that may influence the design of future interconnection networks.
**Course Content**

The following is a tentative list of topics and the number of lectures spent discussing each topic (assuming twenty-eight 75-minute lecture periods in a semester). A representative set of papers is also given for each topic. This list is subject to change.

- **Introduction to course and outline of basic concepts and material (1 lecture)**
- **Interconnection Topologies (3 lectures)**
- **Routing and Switching Methodologies (6 lectures)**
- **Router and Switch Implementations (4 lectures)**
- **Midterm exam (1 lecture)**
- **Interconnect Technologies (6 lectures)**


- Optical Interconnects (3 lectures)

- System-Area Networks and Network Interfaces (4 lectures)

Assignments and Grading

The overall grade will be a weighted average of the following components:

- Midterm Exam (20%)
- Final Exam (20%)
- Presentations (20%)
- Project (40%)

Exams (40%)

The final exam will emphasize material covered after the midterm exam.

Presentations (20%)

Each student will prepare at least two presentations based on papers discussed in class. Presentation grades will include both instructor evaluation and peer evaluation, as well as attendance and participation in the peer evaluation of other student presentations.

Project (40%)

The project for this class will be a journal-quality survey paper, on a topic chosen by the student and approved by the instructor.
Course Grade
The total course grade is a weighted average, with the weights described above.

Resources and Policies

Computer Resources

Course home page: http://courses.ncsu.edu/ece785/lec/001/
Message Board: (see home page)

All class announcements will be posted to the message board. The web site will also contain project assignments and other relevant information. The message board is intended for questions and comments about projects, lectures, or anything else. Anyone in the class may post to the message board. If inappropriate material is posted, the message board will be deleted.

I may choose to broadcast an email message to the entire class for time-critical announcements. For the most part, however, you are responsible for getting information in class, from the web site, or from the message board.

Late Assignments

Assignments are due at the beginning of class on the specified date. Late assignments will be not be accepted, except for university-excused absences. If you have a medical excuse or instructor approval, you may receive full credit if the assignment is turned in as soon as possible.

http://www.ncsu.edu/policies/academic_affairs/pols_regs/REG205.00.4.php

Office Hours

Scheduled office hours are held in my office (Centennial Campus) and are reserved for students in this class. I will also be available after class for questions, as needed. You can drop by my office anytime, but if you want to make sure I’m available, call or email me to arrange an appointment.

Academic Integrity

All exams, projects, and presentations are individual assignments, unless otherwise stated in writing. Evidence of cheating, plagiarism, or other violations of the Code of Student Conduct will be investigated and, if appropriate, referred to the Office of Student Conduct for disciplinary review.

Recycling of projects from another class will be considered an academic integrity violation. If you wish to extend or refine the work done for another class project, this must be approved in advance, and you must provide the results from the previous project.

Code of Student Conduct:
http://www.ncsu.edu/policies/student_services/student_discipline/POL11.35.1.php

Office of Student Conduct:
http://www2.ncsu.edu/student_affairs/osc/

Inclement Weather

The class will follow the University’s closure policy. If classes are not cancelled, I will make every effort to be in class on time, and so should you. Please do not send me email asking whether class is going to meet. Instead, check the University website or the weather hotline (513-8888).

Students with Disabilities

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with Disability Services for Students at 1900 Student Health Center, Campus Box 7509, 515-7653.
http://www.ncsu.edu/provost/offices/affirm_action/dss/
For more information on NC State's policy on working with students with disabilities, please see: 
http://www.ncsu.edu/provost/hat/current/appendix/appen_k.html