UNIVERSITY OF KENTUCKY
APPLICATION FOR CHANGE IN EXISTING COURSE: MAJOR & MINOR

1. Submitted by College of Engineering Date 1/26/04
Department/Division offering course Electrical and Computer Engineering

2. Changes proposed:
   (a) Present prefix & number CS 480G Proposed prefix & number
   (b) Present Title Advanced Computer Architecture
       New Title Advanced Computer Architecture
   (c) If course title is changed and exceeds 24 characters (including spaces), include a sensible title (not to exceed 24 characters) for use on transcripts:
   (d) Present credits: 3 Proposed credits: 3
   (e) Current lecture: laboratory ratio Proposed:
   (f) Effective Date of Change: (Semester & Year) Fall 2004

3. To be Cross-listed as: EE 480

4. Proposed change in Bulletin description:
   (a) Present description (including prerequisite(s)):
       See attachment.
   (b) New description:
       See attachment.
   (c) Prerequisite(s) for course as changed: EE/CSE 380

5. What has prompted this proposal?
The development of the new Computer Engineering Degree program.

6. If there are to be significant changes in the content or teaching objectives of this course, indicate changes:
None.

7. What other departments could be affected by the proposed change?
Computer Science: None.

8. Is this course applicable to the requirements for at least one degree or certificate at the University of Kentucky? ☐ Yes ☐ No

9. Will changing this course change the degree requirements in one or more programs?* If yes, please attach an explanation of the change.*
   ☐ Yes ☐ No

10. Is this course currently included in the University Studies Program?
    If yes, please attach correspondence indicating concurrence of the University Studies Committee.
    ☐ Yes ☐ No

11. If the course is a 100-200 level course, please submit evidence (e.g., correspondence) that the Community College System has been consulted.

*NOTE: Approval of this change will constitute approval of the program change unless other program modifications are proposed.

ORIGINAL NOV 29 2004
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12. Is this a minor change? ☐ Yes ☐ No
   (NOTE: See the description on this form of what constitutes a minor change. Minor changes are sent directly from the Dean of
   the College to the Chair of the Senate Council. If the latter deems the change not to be minor, it will be sent to the appropriate
   Council for normal processing.)

13. Within the Department, who should be consulted for further information on the proposed course change?
   Name: Dr. Kevin Donohue  Phone Extension: 257-4004

Signatures of Approval:

Department Chair

Dean of the College

Dr. Kevin Donohue

**Undergraduate Council

**Graduate Council

**Academic Council for the Medical Center

**Senate Council

Date of Notice to the Faculty

11-16-04

Date of Notice to University Senate

2/3/04

2/7/04

4/1/04

ACTION OTHER THAN APPROVAL

**********

The Minor Change route for courses is provided as a mechanism to make changes in existing courses and is limited to one or more of
the following:

a. change in number within the same hundred series;
b. editorial change in description which does not imply change in content or emphasis;
c. editorial change in title which does not imply change in content or emphasis;
d. change in prerequisite which does not imply change in content or emphasis;
e. cross-listing of courses under conditions set forth in item 3.0;
f. correction of typographical errors. [University Senate Rules, Section III - 3.1]
Present description for CS 480G:

This course focuses on advanced computer architectures and low-level system software. Topics include RISC architectures, vector and multiprocessor architectures, multiprocessor memory architectures, multiprocessor interconnection networks, peripheral devices such as disk arrays, NICs and video/audio devices, device drivers, interrupt processing, advanced assembly language programming techniques, and assemblers, linkers, and loaders. Prereq: CS/EE 380 and graduate or engineering standing.

New description for EE 480/CS 480G:

This course focuses on advanced computer architectures and low-level system software. Topics include RISC architectures, vector and multiprocessor architectures, multiprocessor memory architectures, and multiprocessor interconnection networks. Peripheral devices such as disk arrays, NICs, video/audio devices are covered. Topics also include device drivers, interrupt processing, advanced assembly language programming techniques, assemblers, linkers, and loaders. Prereq: EE/CS 380.
Summary and Syllabus for
EE480/CS480G

EE 480 / CS 480G - ADVANCED COMPUTER ARCHITECTURE

CATALOG DATA:

EE 480 / CS 480G Advanced Computer Architecture: 3 Credits

This course focuses on advanced computer architectures and low-level system software. Topics include RISC and other modern processor concepts, vector and multiprocessor architectures, multiprocessor memory architectures, and interconnection networks. The structure and use of complex peripherhal devices such as disk arrays, NICs (Network Interface Cards), video and audio devices are covered. Topics also include device drivers, interrupt processing, advanced assembly language programming techniques, assemblers, linkers, and loaders.

TEXTBOOK:


This textbook, also used in EE 380 / CS 380, will serve primarily as a reference; additional materials will be distributed via the course WWW site.

COORDINATOR:

Dr. Henry G. Dietz, Professor and Hardymon Chair in Networking

GOALS:

The goals of this course are give students an understanding of advanced computer architectures and to develop in students the ability to view a complete computing system (computer hardware, peripherals, and low-level system software) as an integrated whole, so that they can appreciate wisely manage the various engineering tradeoffs and interactions.

PREREQUISITE:

EE 380 / CS 380 and engineering standing

TOPICS:
1. Advanced processor architecture (~5 weeks)
   - Basic pipelined hardware and software issues
   - Value forwarding
   - Instruction scheduling and register renaming
   - Branch handling and BTBs
   - Caches
   - Page tables and TLBs
2. Introduction to parallel architecture (~3 weeks)
   - SIMD, Vector, SWAR, and Streaming/GPU architecture
   - VLIW, Superscalar, and EPIC architecture
   - MIMD architecture
   - Shared-Memory implementations
   - Interconnection Networks
3. High-performance peripherals (~2 weeks)
   - RAID (Redundant Array of Inexpensive Disks)
   - NICs (Network Interface Cards)
   - Video and Audio I/O
4. Systems programming (~3 weeks)
   - Assemblers, linkers, loaders, and dynamic libraries
   - Device drivers and interrupt-driven processing
   - OS-bypass I/O and other advanced mechanisms
5. Project-related discussions/presentations (~2 weeks)
   - Projects involving architectural implementation
   - Projects involving system software implementation

OUTCOMES:

Upon completion of this course the students should demonstrate the ability to:

1. Understand advanced architectural concepts used in state-of-the-art processor architectures
2. Understand the characteristics of various types of parallel computer architectures and engineering trade-offs between them
3. Understand the characteristics of high-performance peripheral devices such as RAID and NICs
4. Implement (e.g., by simulation) portions of a specific architecture that include one or more advanced features
5. Implement portions of system software that interact with architectural features discussed in the course
6. Design and conduct experiments to determine the effects of system-level interactions between architecture and system software

GRADUATE AND UNDERGRADUATE GRADING:
Students will be graded using (at least two in-class) exams, projects, and homework assignments. There may be either a final exam or a final project. For large projects undertaken as group efforts, peer evaluations and other methods may be used to determine the performance of each student within a team.

Undergraduate Grade Weight:
40% Exams
40% Projects
20% Homeworks

Undergraduate Grade Scale
100-90% A
90-80% B
80-70% C
70-60% D
60% and below E

Although this is primarily a course intended for undergraduates, the CS 480G course designation allows graduate students to enroll. Graduate students take identical exams, but are given larger, more open-ended, project assignments, always including a significant final project. Further, graduate students are expected to produce correspondingly more complete documentation for all their projects, and may be required to give oral presentations of their final projects.

Graduate Grade Weight:
40% Exams
50% Projects
10% Homeworks

Graduate Grade Scale
100-92% A
92-84% B
84-75% C
75% and below E

COMPUTER USAGE:

Student projects will involve implementing architectural structures and systems software that interacts with such structures, both using simulators. This work will be done at least in part using in a UNIX (Linux) X-Windows environment. Thus, students also gain experience in using networked engineering workstations.

LABORATORY:
There will be 3-5 projects involving implementation of architectural structures and systems software that interacts with such structures. These experiments will be primarily implemented by simulation using machines in the laboratory designated to be used for this course (e.g., the Open Computing Laboratory).

DESIGN CONTENT:

Students will be designing significant portions of both an advanced architecture and the systems software with which such an architecture interacts. Many homework problems are design based.

CLASS SCHEDULE:

Lecture 3 hours per week.

PROFESSIONAL CONTRIBUTION:

Engineering Science: 1.5 Credits (50%)

Engineering Design: 1.5 Credits (50%)

RELATION OF COURSE TO PROGRAM OBJECTIVES:

These course outcomes fulfill the following program objectives:

- An ability to apply knowledge of mathematics, science, and engineering.
- An ability to design and conduct experiments, as well as to analyze and interpret data.
- An ability to design a system, component, or process to meet desired needs.
- An ability to identify, formulate, and solve engineering problems.
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

PREPARED BY: Henry G. Dietz DATE: April 29 2004
I. PROGRAM DESCRIPTION

1.01 Curriculum:

a. Describe the curriculum of the proposed program and indicate the semester by semester sequence of courses taken by a typical student to complete the program. Identify the instructor for each departmental course.

b. Designate with an asterisk those courses required.

*Curriculum*

The CpE curriculum has been designed to ensure that students obtain fundamental knowledge and analysis and design skills related to the hardware and software aspects of computer systems along with a good background in both EE and CS. All CpE students progress through an extended sequence of introductory, intermediate, and advanced courses in these areas.

Most of the courses listed in the CpE curriculum are currently required or normally offered elective courses for either the EE or CS degree programs. Thus only a few additional courses are required for the computer engineering degree program. The demand, however, for the CpE related courses is very high and not every student wanting to take the CpE related course can get in. CpE courses will be taught by faculty from both the ECE and CS departments, and therefore resources will be required by both programs to expand to meet student need.

Table I details the course requirements for the proposed CpE degree by semester. The full course descriptions are included in the accompanying accreditation documentation and undergraduate catalog. Descriptions for the new or modified courses are provided in this document following Table I.

*Table I. Typical Semester by Semester Plan of Study*

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA 113</td>
<td>Calculus I</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>EE 101/CS101</td>
<td>Computer Engineering Profession</td>
<td>(Various CS and ECE faculty)</td>
<td>1</td>
</tr>
<tr>
<td>ENG 101</td>
<td>English Composition I</td>
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<td>3</td>
</tr>
<tr>
<td>CHE 105</td>
<td>General Chemistry I</td>
<td></td>
<td>3</td>
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<tr>
<td>CS 115</td>
<td>Introduction to Computer Programming</td>
<td>(Instructor (Keene))</td>
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<td>Semester 2</td>
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<td></td>
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<tr>
<td><strong>MA 114</strong>*</td>
<td>Calculus II</td>
<td>4</td>
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<tr>
<td><strong>PHY 231</strong>*</td>
<td>University Physics I</td>
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<tr>
<td><strong>PHY 241</strong>*</td>
<td>University Physics Laboratory I</td>
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</tr>
<tr>
<td><strong>ENG-102</strong>*</td>
<td>English Composition 2</td>
<td>3</td>
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</tr>
<tr>
<td><strong>CS 215</strong>*</td>
<td>Introduction to Program Design, Abstraction, and Problem Solving</td>
<td>Instructor (Piwowarski)</td>
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<td><strong>Total Credit Hours</strong></td>
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<th>Semester 3</th>
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<tr>
<td><strong>MA213</strong>*</td>
</tr>
<tr>
<td><strong>EE 211</strong>*</td>
</tr>
<tr>
<td><strong>PHY 232</strong>*</td>
</tr>
<tr>
<td><strong>PHY 242</strong>*</td>
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<td><strong>EE 280</strong>*</td>
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<td><strong>EE 281</strong>*</td>
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<td><strong>Total Credit Hours</strong></td>
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<table>
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<th>Semester 4</th>
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<tbody>
<tr>
<td><strong>MA 214</strong>*</td>
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<tr>
<td><strong>CS 275</strong>*</td>
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<tr>
<td><strong>CS 216</strong>*</td>
</tr>
<tr>
<td><strong>EE/CS 380</strong>*</td>
</tr>
<tr>
<td><strong>USP Social &amp; Behavioral Sciences</strong></td>
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<td><strong>Total Credit Hours</strong></td>
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### Semester 5

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<th>Credit Hours</th>
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<tbody>
<tr>
<td>EE 221*</td>
<td>Circuits II</td>
<td>Instructor (Gedney)</td>
<td>3</td>
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<tr>
<td>EE 222*</td>
<td>Circuits Laboratory</td>
<td>Instructor (Smith)</td>
<td>2</td>
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<tr>
<td>CS 315*</td>
<td>Algorithm Design and Analysis</td>
<td>Instructor (Klapper, Jaromezyk)</td>
<td>3</td>
</tr>
<tr>
<td>EE 383*</td>
<td>Embedded Systems</td>
<td>Instructor (Lumpp)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>USP Social &amp; Behavioral Sciences</td>
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<td>3</td>
</tr>
<tr>
<td></td>
<td>USP Communications</td>
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<td>3</td>
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<tr>
<td><strong>Total Credit Hours</strong></td>
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### Semester 6

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<td>STA 381*</td>
<td>Engineering Statistics</td>
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</tr>
<tr>
<td>EE 461*</td>
<td>Introduction to Electronics</td>
<td>Instructor (Singh)</td>
<td>3</td>
</tr>
<tr>
<td>CS 470*</td>
<td>Operating Systems</td>
<td>Instructor (Baxter, Finkel, Manavinnan, Griffioen)</td>
<td>3</td>
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<td>EE 480*</td>
<td>Advanced Computer Architecture</td>
<td>Instructor (Dietz)</td>
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</tr>
<tr>
<td></td>
<td>USP Humanities</td>
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<td>3</td>
</tr>
<tr>
<td><strong>Total Credit Hours</strong></td>
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### Semester 7

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<th>Title</th>
<th>Instructor(s)</th>
<th>Credit Hours</th>
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<tr>
<td>EE 421*</td>
<td>Signals &amp; Systems I</td>
<td>Instructor (Holloway)</td>
<td>3</td>
</tr>
<tr>
<td>CS 441*</td>
<td>Compilers for Algorithmic Languages</td>
<td>Instructor (Jaromezyk)</td>
<td>3</td>
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<td>EE/CS Technical Elective</td>
<td>(Various CS and ECE faculty)</td>
<td>3</td>
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<tr>
<td></td>
<td>EE/CS Technical Elective</td>
<td>(Various CS and ECE faculty)</td>
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</tr>
<tr>
<td></td>
<td>Supportive Elective</td>
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</tr>
<tr>
<td></td>
<td>Technical Elective</td>
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<td>3</td>
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<tr>
<td><strong>Total Credit Hours</strong></td>
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<tr>
<td>Course</td>
<td>Proposal</td>
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<tr>
<td>------------------------------</td>
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<tr>
<td>EE281 - Logical Design Laboratory</td>
<td>minor change - 400 to 200 level change</td>
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<tr>
<td>EE383 / CS383 - Introduction to Embedded Systems</td>
<td>new course</td>
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</tr>
<tr>
<td>EE480 / CS480G - Advanced Computer Architecture</td>
<td>&quot;new&quot; - major redesign - course was proposed by CS as CS-480G but has not been offered.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Descriptions of new and modified courses:**

**EE281 Logic Design Laboratory:** A laboratory involving the design and implementation of logic circuits. Combinational and sequential (both synchronous and asynchronous) design examples using small and medium scale integrated circuits. Lecture one hour, laboratory, one three - hour session. Co requisite: EE 280.

**EE383 / CS383 - Introduction to Embedded Systems:** A course in the hardware and software of microprocessors. Assembly language programming, address decoding, hardware interrupts, parallel and serial interfacing with various special purpose integrated circuits. Each student is expected to do homework assignments using microprocessor hardware. This will be arranged by special appointment through the instructor. Prerequisite: EE/CS 380.
EE480 / CS480G: Advance Computer Architecture: This course focuses on advanced computer architectures and low-level system software. Topics include RISC architectures, vector and multiprocessor architectures, multiprocessor memory architectures, and multiprocessor interconnection networks. Peripheral devices such as disk arrays, NICs, video/audio devices are covered. Topics also include device drivers, interrupt processing, advanced assembly language programming techniques, assemblers, linkers, and loaders.
Prerequisite: EE/CS 380.
Privett, Dawn

From: Kevin Donohue [donohue@engr.uky.edu]
Sent: Tuesday, January 18, 2005 1:36 PM
To: Privett, Dawn; Scott, Rebecca M; Hager, Jacquie; Donohue, Kevin D
Cc: Patterson, Matt; Tony Baxter
Subject: RE: CS 480 G to EE 480 & EE 583 change

Dawn,

Thanks for processing through these details. In regards to your questions on cross-listing CS480G/EE480, your suggestion in Problem 1 is fine. That was our intention to simply have it cross-listed so that faculty from either CS or ECE can teach it.

For Problem 2, only the CS and EE programs will be affected. Students from other disciplines would not typically take this course. So putting down as we did that COSC would be affected by the change is redundant, and we probably should have said simply that no other departments would be affected by this change.

Did that address your questions? If not, you can also call me (257-4004) I will be in my office most of the afternoon.

-Kevin Donohue
DataBeam Professor of Electrical and Computer Engineering,
and Director of Undergraduate Studies
University of Kentucky

-----Original Message-----
From: Privett, Dawn [mailto:Dawn.Privett@uky.edu]
Sent: Tuesday, January 18, 2005 9:45 AM
To: Scott, Rebecca M; Hager, Jacquie; Donohue, Kevin D
Cc: Patterson, Matt
Subject: RE: CS 480 G to EE 480 & EE 583 change

Hello, all. Below is an update on the course proposals. Dr. Donohue: Please reply to this message concerning the CS 480 change. Marilyn Lyons had some questions about the proposal which I included below. Once this is cleared up, this proposal will be ready for Graduate Council as well. Thank you,
Dawn

EE 583
The proposal to change EE 583 to EE 383 will be a newly assigned item on the Graduate Council agenda for 1/20/05.

CS 480 G
There were just a few problems/questions I had about the proposal to change CS 480 to EE 480:

Present Prefix: CS 480 G  Proposed Prefix: EE 480
To be cross-listed as: CS 480 G

Problem 1: Changing the prefix/number, but cross-listing with the old prefix/number is confusing.
   Suggestion: Just add a cross-listing for EE 480, and make that the only change.

Problem 2: What other departments could be affected by the proposed change?
   "Computer Science"
   But it is a COSC course, Should read COSC and EE

1/18/2005
-----Original Message-----
From: Scott, Rebecca M
Sent: Thursday, January 13, 2005 3:25 PM
To: Hager, Jacquie; Privett, Dawn
Cc: Patterson, Matt
Subject: RE: Electrical Engineering Program

EE 583 is being changed to EE 383, but is currently awaiting Graduate Council approval. CS 480G is changing to EE 480, but is also awaiting Graduate Council approval. I will copy Dawn on my reply to you to see if we can get an update on how these two courses are progressing through Grad Council.
Thanks!
Rebecca

From: Hager, Jacquie
Sent: Thursday, January 13, 2005 2:07 PM
To: Scott, Rebecca M
Cc: Patterson, Matt
Subject: Electrical Engineering Program

The application for the change in the Electrical and Computer Engineering program indicates there are new courses associated with this change - EE 383/CS 383 and EE480 to be crosslisted with CS 480G. The college says they are wanting to implement this program change but where are these courses? They are not with the program change. Thanks!

Jacquie Hager