Commonwealth of Kentucky

COUNCIL ON POST-SECONDARY EDUCATION
1050 U.S. 127 South
Frankfort, Kentucky 40601

PROPOSAL FOR INITIATION OF A NEW DEGREE PROGRAM

Bachelor of Science in Computer Engineering

Institution Submitting Proposal: **University of Kentucky**

College, School or Division: **College of Engineering**

Academic Major: **Department of Electrical and Computer Engineering**

Proposed Starting Date: **January 2004**

Suggested CIP Code.....

Approved by Board of Regents/Trustees on.....

President:

Signature.....

Date.....

Approved by
UNDERGRADUATE COUNCIL
11-16-2004

revised
11-7-03

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Bachelor of Science in Computer Engineering
A New Degree Program

Program Summary

In order to respond effectively to the changing needs of students, industry and society at large, we propose the establishment of a new Bachelor of Science in Computer Engineering degree program in the College of Engineering at the University of Kentucky.

The Field

Computer engineering (CpE) involves the design, operation, and analysis of computer systems, which include both hardware and software components. Careers in CpE focus on the development of independent computer systems and embedded computer systems found in consumer products such as medical devices, automobiles, aircraft, trains, telecommunication systems, and other information systems. According to the Bureau of Labor Statistics, Computer Engineering is one of the fastest growing occupations. (see Fig. 1)

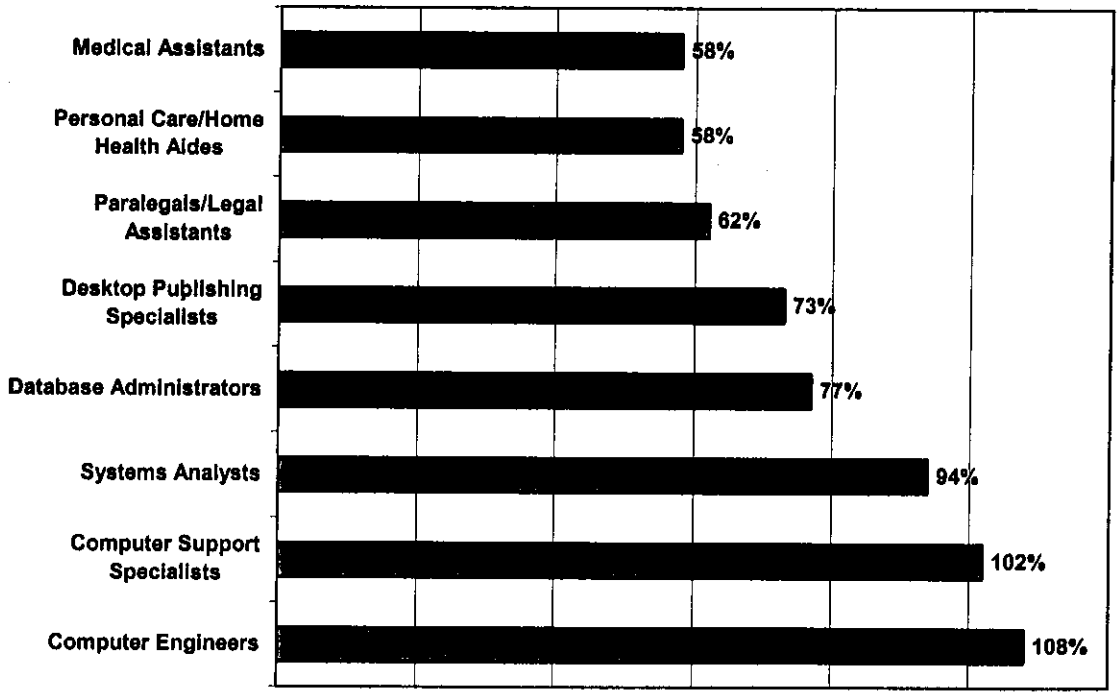

Fig. 1 Fastest Growing Jobs (Bureau of Labor Statistics for 1998 – 2008)

The Goals

The primary goal of the undergraduate CpE degree program is to provide a solid education in the fundamentals of both the hardware and software aspects of computer systems along with their applications including embedded systems. Graduates of this program are prepared either to enter into professional practice or to continue with advanced education in a suitable graduate degree program. The program provides students with technical qualifications necessary to solve the engineering problems of tomorrow, which includes skills related to problem solving, teamwork, and communication. In addition, the program raises student awareness of the social and ethical issues related to technology, and stresses the need for continuous education throughout their careers.

The Impact

This program will attract new students who now attend other universities because of the University of Kentucky does not have a separate computer engineering degree. The proposed program will offer students a more efficient path to a CpE career and provide a credential that more explicitly describes their focused area of study. Currently, students who are interested in CpE must major in electrical engineering (EE), computer science (CS), or double major. It is estimated that a steady-state enrollment of 220 students undergraduate will be achieved in 5 years. Tuition revenue from these students is estimated to be in excess of $800,000 annually.

The Need

The University of Kentucky needs a computer engineering degree for many reasons, including,

(i) The Commonwealth of Kentucky needs trained computer engineering graduates for the sustenance and growth of its high-tech industry.
(ii) Many new students interested in science and engineering want to pursue a degree in computer engineering.
(iii) Our competitor universities offer this degree and our enrollments have been decreasing as a result.
(iv) Computer engineering has the fastest growing job projection rates for 1998-2008 (Bureau of Labor Statistics, see Fig. 1)

In order to fulfill our obligations to the Commonwealth and our mission of becoming a great university, we must offer the programs and degrees that other great universities offer and students demand.

I. MISSION, INFLUENCE, ORGANIZATION

1.01 Consistency with Mission:

State the relevance of this program to the institution's mission and to its long-range instructional plan.

Consistency with the University Mission

The goals of the proposed Computer Engineering program are consistent with the educational mission of the University as a whole. They serve the Commonwealth by providing highly trained engineers who will be competitive in the job market and improve the technical infrastructure of the state and nation, so modern high-tech businesses can succeed.

Consistency with the College Mission

The College mission statement and vision statements are:

Mission Statement

To provide education, research, and service in a scholarly environment in a way that:

- Prepares our students for successful professional career;
- Addresses the changing needs of our other constituents; and
- Responds to the technological challenges facing the Commonwealth and the nation.

Vision Statement

We aspire to make the College of Engineering one of the nation's great engineering schools, recognized nationally and internationally for excellence in teaching, research, and public service. We seek to be the preferred choice of students and practitioners seeking an engineering education, employers hiring engineering graduates, and organizations seeking advanced engineering knowledge.

Therefore, the proposed degree program is consistent with the missions of the College of Engineering and the University of Kentucky. Employers hiring engineering graduates need well-trained professionals in computer engineering and computer engineering is a preferred choice of a large and growing number of students.

1.02 Internal and External Influences:

a. Briefly describe any identified institutional, local, and regional needs to which the proposed program would be responsive (do not include manpower need data).

Institutional:
The program would bring additional high quality students to the University of Kentucky. Many students choose other universities because the University of Kentucky does not offer this degree option. This conclusion is based on inquiries about the Computer Engineering degree from high school students in the region and on experience at other institutions in U.S. (See Appendix 1).

Local:
Industry needs computer engineers. Lexmark, Cypress Semiconductors, Data Beam, and IBM Lotus are a few examples of such industry.

Regional:
Computer engineers are needed by industry across the Commonwealth of Kentucky as well as neighboring states. Both large and small companies need computer engineers for developing new products, enhancing their current products, and staying competitive.

Based on many inquiries into our program and the growth of computer engineering programs elsewhere, students in Kentucky and neighboring states are interested in obtaining computer engineering degrees.

b. Describe any unusual or special faculty/student needs to which the program would be responsive.

Faculty Need:
Over the last decade more and more Electrical Engineering Departments across U.S.A. have added computer engineering degree program to their offerings. Departments that have failed to make this addition have had difficulty recruiting high quality faculty to their ranks. The ECE department at UK has experienced this problem in a few hiring cases also.

Student Need/Student Demand:
Expected student demand promises to be very strong. The need for computer engineers at both the local and national level is growing rapidly, with over 40% of US software, hardware, and telecommunications companies projecting growth of 25% or more. Enrollment in similar programs at universities across U.S. provides evidence of student demand throughout the country. Prospective students are very aware of employment opportunities for individuals with these skills (see Fig. 1), and their selection of a school and curriculum of study is strongly

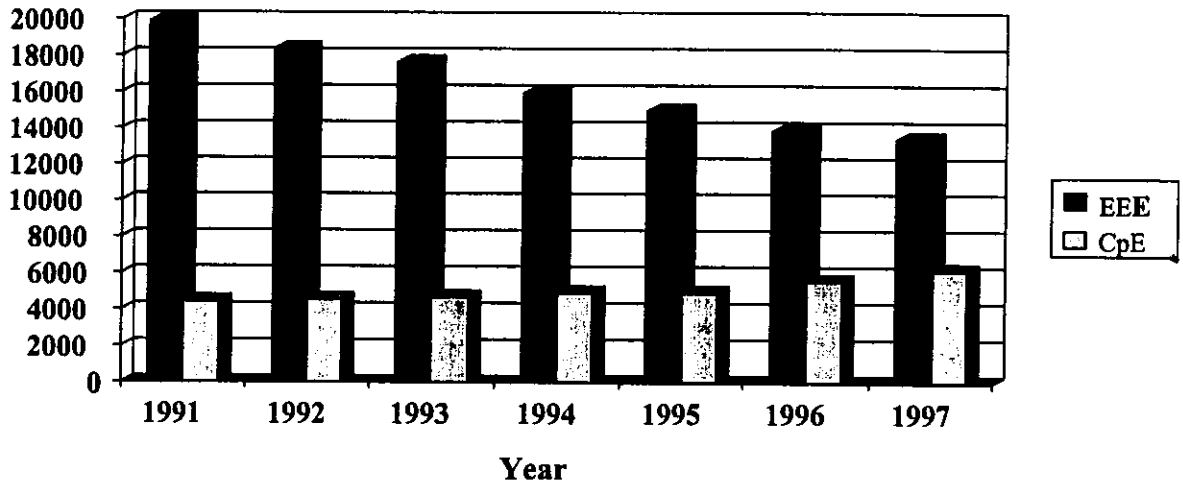

Figure 2. Degrees Produced Nationally

influenced by the prospect for a well paying and interesting job after graduation.

Data supporting Students Demand*

The 1997 report of the Engineering Workforce Commission of the American Association of Engineering Societies (AEES) shows that the interest in Computer Engineering programs across the US has been constantly rising for over five years. Figure 2 compares national electrical engineering (EE) degree output to computer engineering (CpE) degree output. This figure shows the increase in the number of CpE degrees produced is having an impact on the number of EE degrees produced.

This change is taking place due to the fact that new CpE programs are continually being created and are replacing CpE concentrations within existing EE programs. The trend in the creation of new CpE programs is taking place because of both the increased interest in CpE and the inability to sufficiently augment the standard EE to include the necessary computer related courses.

The growth in CpE programs has reached a situation where the number of CpE degrees produced is becoming equivalent to the size of the classical engineering programs such as electrical engineering, chemical engineering, and mechanical engineering. For example, the number of CpE degrees produced in 1997 was roughly the same as the number of chemical engineering degrees produced. The total number of CpE

* For this information, the author is grateful to Dr. James Aylor, Louis T. Rader Professor and Chair, ECE Dept., University of Virginia.

undergraduates registered in 1996 in the US was 39,675 as compared to 56,144 EE undergraduates.

Recent data from the Engineering Workforce Commission shown in Fig. 3 reinforces the point that there is a significant student demand for computer engineering programs. While for the past 20 year computer engineering has been a sub discipline of Electrical Engineering (which was reflected in that most Electrical Engineering department change their names from Electrical Engineering to Electrical and Computer Engineering), many of these departments are now offering separate computer engineering degree program so student can focus more on the computer specialty through out their program. The programs that have launched degree programs now have students who would have selected the University of Kentucky had we offered a similar program. The statistics in Fig. 3 clearly support our projection of 220 new students, even if all of our current EE students switch to computer engineering. Therefore the 220 new students can be considered a conservative estimate. Appendix I (page 43) provides additional supporting data on student demand in other institutions.

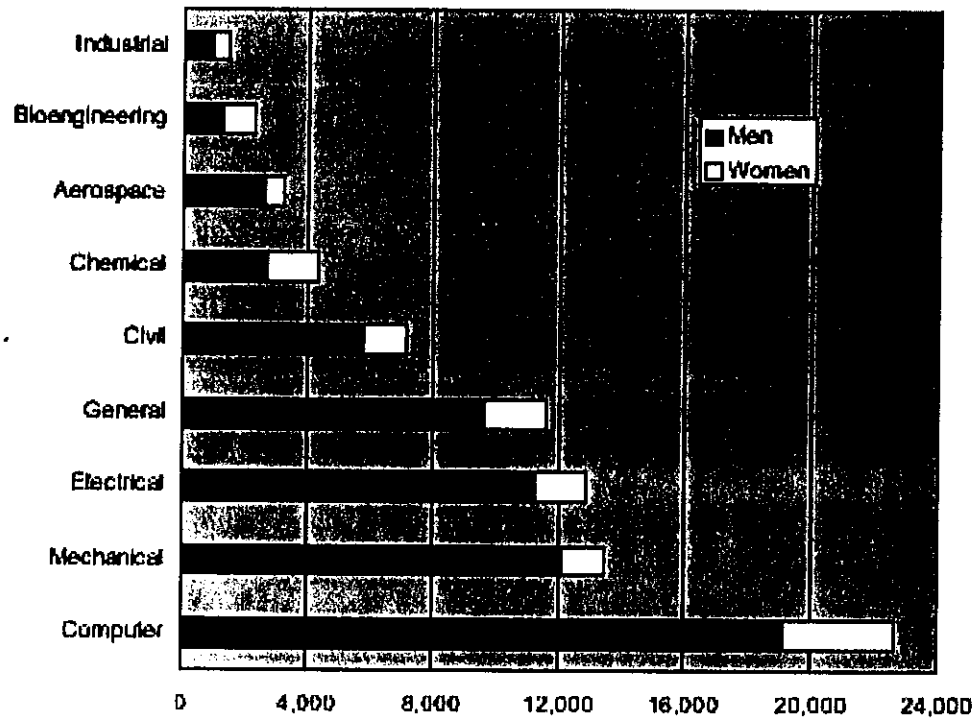

Figure 3. National engineering enrollments with the most Freshmen Fall 2001 by discipline, taken from Engineering and Technology Enrollment Fall 2001.

c. Describe any exceptional circumstances that favor this development of the program. For example, special facilities, grants, patrons, etc.

The Electrical and Computer Engineering (ECE) department already offers 14 CpE courses taught by seven faculty members. About an equal number of faculty members in the Department of Computer Science (CS) also offer a similar number of computer engineering courses. Thus, only a limited number of new courses and laboratories will be needed to initiate the new CpE degree program.

The proposed development has also been encouraged by a recent grant from the National Science Foundation (NSF), titled, "Embedded Computer Engineering" with Dr. H Dietz listed and the PI along with other professor from the computer science and education department. The grant involves planning a series of course, laboratory and curriculum developments with a funding level of $99,460.00 for 12 months. This will followed up by an implementation proposal to the same agency.

The following laboratories are currently available:

Logic design Laboratory (EE481)

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 per week.

Microcomputer System Design Laboratory (EE587)

A laboratory involving the design of microcomputer systems for hardware engineers which includes the following topics; use of uncommitted logic arrays in instructions set design; hardware support for operating systems and programming languages; customizing microcomputers for specific execution environments and concurrency.

Laboratory For Advanced Networking:

A laboratory involving computer and switching networks, immersive displays, image processing and computer vision.

General Computing Laboratories:

The University supports many general-purpose computing laboratories. These will be sufficient for the needs of CpE students.

Research Laboratories:

Several faculty sponsored research laboratories are being used for graduate, and some undergraduate projects and research. These laboratories are tailored to the specific research interests of faculty. Currently laboratories are available in the areas of computer clusters,

distributed computing, advanced networking, parallel processing, high-performance computing, computer vision and visualization, VLSI design and testing, computer architecture, and embedded computing.

Research grants totaling more than two million dollars have been awarded to the faculty at the University of Kentucky in the computer engineering specialty area over the past 5 year period. The University of Kentucky is gaining national and international recognition and is poised to take a leadership position in the areas of networking, visualization, computer architecture and computer clusters. Computer cluster research at UK has been recognized nationally through prestigious Golden Bell Award and the Computer World's Smithsonian Award.

UK alumnus Mr. James. F. Hardymon has made substantial donations to promote computer engineering activities through the new James F. Hardymon Center for Advanced Networking Building.

1.03 Relationship to University Organizational Structure:
Describe the organizational placement of the program within the institution's organizational structure.

The computer engineering degree program will reside in the Department of Electrical and Computer Engineering (ECE) and will be administered by the ECE Chair. However, the faculty from the Department of Computer Science (CS) will share equally in resources, responsibilities, teaching of courses, and advising of students.

Relationship to University Organizational Structure:

-University of Kentucky
-College of Engineering
-Department of Electrical and Computer Engineering
-Computer Engineering Degree Program

II. PROGRAM DESCRIPTION

2.01 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 1. Typical Semester by Semester Plan of Study

Semester 1			
MA 113*	Calculus I		4
EE 101 or CS101*	Computer Engineering Profession	(Various CS and ECE faculty)	1
~~ENG 101*~~ Eng 104	~~English Composition I~~		~~3~~ 4
CHE 105*	General Chemistry I		3
CS 115*	Introduction to Computer Programming	(Instructor (Keene)	3

	~~USP Humanities~~		~~3~~
Total Credit Hours			~~17~~ 15

Semester 2			
MA 114*	Calculus II		4
PHY 231*	University Physics I		4
PHY 241*	University Physics Laboratory I		1
~~ENG 102~~*	~~English Composition 2~~ usp Social + Behavioral Sciences		~~3~~ 3
CS 215*	Introduction to Program Design, Abstraction, and Problem Solving	Instructor (Piwowarski)	4
Total Credit Hours			16

Semester 3			
MA213*	Calculus III		4
EE 211*	Circuits I	Instructor (Donohue)	3
PHY 232*	University Physics II		4
PHY 242*	University Physics Lab II		1
EE 280*	Design of Logic Circuits	Instructor (Dieter)	3
EE 281*	Logic Design Laboratory	Instructor (Dietz)	2
Total Credit Hours			17

Semester 4			
MA 214*	Calculus IV		3
CS 275*	Discrete Mathematics	Instructor (Goldsmith, Marek)	4
CS 216*	Introduction to Software Engineering	Instructor (Piwowarski)	3
EE/CS 380*	Computer Architecture	Instructor (Lumpp)	3
	~~USP Social & Behavioral Sciences~~		~~3~~ 3
Total Credit Hours	USP Humanities		16

Semester 5			
EE 221*	Circuits II	Instructor (Gedney)	3
EE 222*	Circuits Laboratory	Instructor (Smith)	2
CS 315*	Algorithm Design and Analysis	Instructor (Klapper, Jaromczyk)	3
EE 383*	Embedded Systems	Instructor (Lumpp)	3
	USP Social & Behavioral Sciences		3
	USP Communications		3
Total Credit Hours			17

Semester 6			
STA 381*	Engineering Statistics		3
EE 461*	Introduction to Electronics	Instructor (Singh)	3
CS 470*	Operating Systems	Instructor (Baxter, Finkel, Manavinnan, Griffioen)	3
EE 480*	Advanced Computer Architecture	Instructor (Dietz)	3
	USP Humanities		3
Total Credit Hours			15

Semester 7			
EE 421*	Signals & Systems I	Instructor (Holloway)	3
CS 441*	Compilers for Algorithmic Languages	Instructor (Jaromczyk)	3
	EE/CS Technical Elective	(Various CS and ECE faculty)	3
	EE/CS Technical Elective	(Various CS and ECE faculty)	3
	Supportive Elective		3
	Technical Elective		3
Total Credit Hours			18

Semester 8

EE/CS 499*	Senior Design Project	(Various ECE)	3
	EE/CS Technical Elective	(Various CS and ECE faculty)	3
	EE/CS Technical Elective	(Various CS and ECE faculty)	3
	Supportive Elective		3
	USP Cross Cultural		3
Total Credit Hours			15

It is expected that once the CpE degree program is in place, some of the courses listed above may be renamed and revised. Table II provides information on the new and modified courses associated with the proposed CpE curriculum.

Table II. Modified and new courses in the CpE degree program.

Course	Proposal
EE281 - Logical Design Laboratory	minor change – 400 to 200 level change
EE383 / CS383 – Introduction to Embedded Systems	new course
EE480 / CS480G - Advanced Computer Architecture	"new" - major redesign - course was proposed by CS as CS-480G but has not been offered.

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.

2.02 Didactic/Clinical Relationship:

a. If a clinical/experiential component is part of the curriculum, discuss the objectives of this component and how the didactic and clinical/experiential components are integrated into the overall curriculum.

b. List and discuss the nature and appropriateness of clinical sites used for the program. Supply letters of commitment by the provider of each clinical site specifying the number of students that can be accommodated and identifying other programs that also use the facilities. State the number of clinical hours per credit hour for each clinical course.

c. What is the student-faculty FTE ratio for the didactic component and the student-faculty headcount ratio for the clinical/laboratory component of the program?

d. Discuss the nature, location, and availability of experiential/co-op/practicum opportunities required by the program.

There is no clinical component to this program.

2.03 Accreditation/Certification:

Are there recommended curricula and/or other program standards available from an accrediting body, certifying agency, or professional society? If so, identify the source and compare your program with the recommendations and/or standards.

The accrediting body is the Accreditation Board for Engineering and Technology (ABET). The proposed program in computer engineering is in accordance with the requirements of ABET. The ECE Department has its EE undergraduate degree already accredited by ABET and will apply for accreditation of its CpE undergraduate degrees by ABET following the graduation of its first students.

The general standards and curriculum requirements of ABET are already met by the overlap between the EE and CpE degree. The CpE program specific requirements include additional courses in discrete math and analysis of computer systems, which are made requirements in the proposed curriculum.

2.04 Admissions Criteria/Standards/Procedures:

a. List and describe any program admissions or transfer criteria, standards, or procedures which are more specific than your published institution-wide admission or transfer criteria, standards, or procedures.

The proposed program fits within the undergraduate degree structure of the College of Engineering at the University of Kentucky. Therefore, the admission and continuing requirements, as well as the academic rules and regulations are the same as for all undergraduate students in the College. These requirements are described in detail in the University Bulletin. The proposed program requires 131 credits of course work for the B.S. degree.

b. State any provisions you have for advanced placement.

The rules and regulations for advanced placement are expected to be the same as those existing for the EE degree program in the ECE Department.

2.05 Objectives/Evaluations Scheme:

a. Discuss the program objectives and the evaluation scheme for the program.

Overall Objective:

The overall objective of the undergraduate CpE degree program is to provide an education in the fundamentals of the hardware and software aspects of computer systems, and their applications including embedded systems.

Assessment Plan:

All courses and instructors in the College of Engineering are evaluated by the students in the class. The students will evaluate every course in the CpE curriculum each time it is taught. Course and instructor ratings will be compared with school-wide norms and information will be provided to the relevant department chairs and directors of undergraduate studies who will use it for, promotion, tenure, and salary reviews, as well as course/curriculum modification.

Department of ECE will administer an exit survey to its B.S. degree recipients. That instrument will ask students to rate teaching in their

major and in other courses, academic advising, and their progress in such activities as designing and conducting experiments, designing a system component or process, functioning on multidisciplinary teams, understanding professional and ethical responsibility, communicating effectively, and understanding the impact of engineering solutions in a global/societal context.

The College of Engineering will conduct an annual job placement survey of the CpE graduates. This will be monitored to determine if graduates developed the skills required for a successful career. In addition, feedback on curriculum content from the ECE advisory board leaders will also be obtained and changes made to keep the courses and program relevant to industrial and social needs.

More Specific Goals, Outcomes and Evaluation:

Goal 1. Attract highly talented and motivated students to the computer engineering profession.

Objective 1.1: Attract and graduate students in the CpE program, with a B.S. degree.

Outcomes & Assessments:

The main assessment statistics will be graduation and retention rate statistics. A highly talented pool of incoming students will likely survive the rigors of the curriculum in large percentages. Survey results from employers and Co-op employers will also be considered for assessing the level of talent of our graduates

Goal 2. Develop relevant technical skills in our students.

Objective 2.1: Institute and maintain industrial partnerships to:

- improve the quality and relevance of design and implementation experiences;
- assist in reviewing the curriculum for relevance and quality;
- strengthen applied and theoretical research experiences.

Outcomes & Assessments:

We will continue an ongoing review of the curriculum with a team of faculty and external industrial peers to perform a detailed review of individual courses. Particular emphasis will be placed on the applied and research experiences available within the curriculum.

Goal 3. Provide our students the access to rewarding career opportunities.

Objective 3.1: Increase the number of graduates contributing to major companies that offer established career paths for computer engineering professionals.

Outcomes & Assessments:

We will track the initial, and where possible, subsequent, employment of our graduates. A qualitative measure of the strength of their employment will be made with the assistance of industrial representatives.

b. If the program is designed to prepare a student for a particular occupation, describe the competencies the student will have upon completion of the program and how these will be evaluated. ABET out comes?

The graduates of this program will have competencies in the hardware and software aspects of computer systems including the following areas: logic design, computer architecture, software engineering, embedded systems, operating systems, and compiler design.

The College of Engineering will conduct an annual job placement survey of graduates. This will be monitored to determine if graduates possess the skills required for successful careers. In addition, the methods currently used to evaluate course outcome performance in the ECE program will be applied to CS and EE courses in the CpE program. This involves both student self-assessment surveys and faculty evaluation.

The B.S. in computer engineering program will be deemed successful based on satisfaction as assessed by feedback from employers, program graduates, enrolled students, faculty, and the ECE advisory board. The assessment is in accordance with ABET accreditation criteria.

2.05 Advisory Committee:

If an advisory committee had been used in the development of the proposal, identify committee members and their affiliations and describe the committee's role in developing and overseeing the program.

A faculty committee was set up by the Dean of The College of Engineering in 1999 to recommend an approach for establishing a CpE program that will be feasible and well suited for the University of Kentucky (i.e. one that would have faculty, student, and local industry support and would be consistent with university policies and regulations.)

The committee consisted of CS and ECE faculty members and associates in related industries. The members were:

Prof. Anthony Q. Baxter, CS
Mr. John Bender, Lexmark International, Inc
Mr. John Brown, Lexmark International, Inc

Prof. Kenneth L. Calvert, CS
Prof. Henry G. Dietz, ECE
Prof. Raphael A. Finkel, CS
Dr. Michael E. Lhamon, Lexmark International, Inc
Prof. James E. Lumpp, Jr., ECE
Prof. Charles E. Stroud, ECE

The Committee turned in its final report to the Dean in 2001 and will not have a role in overseeing the program. The Committee's report is attached as Appendix II.

2.07 Plans for Articulation/Transfer Cooperation

a. Describe how this program will articulate with related programs in the institution and in the state.

Similar Programs in Kentucky:

Only the University of Louisville and the University of Kentucky offer comprehensive engineering programs. Currently, neither the University of Louisville nor the University of Kentucky offers a separate degreed program in computer engineering.

University of Louisville, Speed Scientific School:

The Electrical and Computer Engineering Department offers the following degrees:

- Bachelor of Science degree in Electrical and Computer Engineering degree (BSECE)
- Master of Engineering degree (MENG)
- Doctor of Philosophy (Ph.D.) Degree in Computer Science and Engineering (CSE)
- Doctor of Philosophy (Ph.D.) Degree in Electrical and Computer Engineering.

UK College of Engineering:

UK currently offers degrees in computer science and electrical engineering at the baccalaureate, masters and doctoral level. There is currently no competing program at the University of Kentucky.

Comparative Programs in Other States:

We have studied programs at the following universities: Purdue, Illinois, Carnegie-Melon, Georgia Tech, Ohio State, Virginia Tech, University of Alabama - Hunstville, and the University of Texas - Austin.

Most of the programs appear to have a distinctive "flavor" depending on the sponsoring department. In schools where the program grew out of an EE program there appears to be a dearth of computer science material. In programs sponsored by CS the opposite is true, namely, there appears to be insufficient foundational education in basic electrical engineering. We believe that this proposal strikes the appropriate balance between the two disciplines.

b. Describe the extent to which student transfer has been explored and coordinated with other institutions.

The first 2 years of the curriculum is similar to the current EE and CS curriculum and transfer students with backgrounds similar to these will be able to efficiently transfer into the CS, EE, or CpE for the final 2 or 3 years at the University of Kentucky. Additional possibilities and improvements in the transfer process are also being considered in ongoing work with Gary Cox and AIKCU to coordinate transfers from private schools.

III. SUPPORTIVE DATA

3.01 Manpower Requirements

a. Is the program designed to prepare students primarily for the local, state, regional, or national market?

The program prepares students for local, state, regional and national markets. All of these have a need for computer engineers.

b. What are the general employment prospects for graduates of the proposed program? What are the specific prospects in the market identified in 3.01a?

Employment Prospects

The demand for technology graduates especially related to the various areas of information technology has been documented in numerous places over the past few years. Nationwide, the need for computer engineers continues to grow at a rate of six percent per year.

Types of Jobs and Opportunities

Computer engineers design, produce, operate, program, and maintain computer and digital systems. They generally apply the theories and principles of science and mathematics to the design of hardware, software, networks, and processes to solve technical problems. Career opportunities exist in virtually every segment of society. Major employers of computer engineers include Microsoft, Intel, IBM, Tektronix, Westinghouse, General Electric, Bell Atlantic, Hughes Network Systems, Texas Instruments, and Lockheed Martin, along with many other companies. In addition, those students who desire to continue their academic career will be well qualified to continue in programs of advanced study in Electrical Engineering, Computer Engineering, and Computer Science.

Need for Computer Engineering Graduates

Several recent publications and survey results demonstrate the need for Computer Engineering graduates. See Fig.1 for data from Bureau of Labor Statistics. It is anticipated that there will be 235,000 job openings for computer engineers due to industry growth and replacement needs. The computer engineer can easily find employment in the general area of information technology.

The demand for computer engineers is of national importance as demonstrated in a quote from Money magazine[1]: "Over the next 10 years,

[1] *Money*, March 1995, pp. 114-117.

computer engineers' handiwork will be felt in every corner of the economy, from business software to video and computer games, from the microchips that trigger your car's air bags to the switching programs that will route old movies and fresh news down the information highway. Talk about marketable skills: U. S. corporations will need about 447,000 computer engineers by the year 2005, more than twice the number in the country today."

3.02 Similar Programs in Kentucky

a. Identify similar programs available elsewhere in the state. Please provide a five-year enrollment and degrees conferred history for each of these programs.

Only the University of Louisville and the University of Kentucky offer comprehensive engineering programs. Currently, neither the University of Louisville nor the University of Kentucky offers an accredited separate CpE program as proposed.

University of Louisville, Speed Scientific School

The Electrical and Computer Engineering Department offer the following degrees:
Bachelor of Science in Electrical and Computer Engineering (BSECE)
Master of Engineering (MENG)
Doctor of Philosophy (Ph.D.) in Computer Science and Engineering (CSE)
Doctor of Philosophy (Ph.D.) in Electrical and Computer Engineering.

UK College of Engineering

UK currently offers degrees in Electrical Engineering and Computer Science at the baccalaureate, masters and doctoral level. There is currently no competing program at the University of Kentucky.

b. Do you consider this proposed program unnecessarily duplicative of any of these existing programs? Please provide the rationale for your response.

The program does not unnecessarily duplicate any similar existing program. There is high demand from the students and the industry for computer engineering and other related programs like electrical engineering and computer science. In addition, there is not other separate CpE degree program in the state.

c. Describe how your proposed program may affect enrollment in similar programs within the state.

The fact that transfers between the University of Kentucky and University of Louisville's electrical and computer related programs are small is evidence of student satisfaction and loyalty to the programs. It is unlikely that there will be a significant draw from the University of Louisville. Students wanting to pursue graduate degrees at other institutions in CpE will likely select the University of Kentucky's program because of accreditation issues. But this number will likely not be significant as full-time graduate school is only pursued by a small percentage of the students. It is expected that we will draw Kentucky students currently going to other universities in neighboring states.

d. Have you examined the possibility of collaborative and/or sharing of resources with similar programs within the state? What were the results of your examination?

A separate CpE degree program currently does not exist in the state. In addition, related programs already have significant overlap in the curriculum and high student demand. The distance between Louisville and Lexington makes sharing what few resources that may be available infeasible.

3.02 Comparative Programs in Other States

a. Identify those benchmark institutions, which have comparable (similar) programs and indicate major similarities and differences.

A comparative study of similar programs at the following universities was done: Purdue, Illinois, Carnegie-Melon, Georgia Tech, Ohio State, Virginia Tech, University of Alabama - Huntsville, Stanford, and the University of Texas - Austin.

Most of the programs appear to have a distinctive "flavor" depending on the sponsoring department. In schools where the program grew out of an electrical engineering program there appears be, typically, a dearth of computer science material. In programs sponsored by computer science the opposite is true, namely, there appears to us to be insufficient foundational education in basic electrical engineering. We believe that this proposal strikes the appropriate balance between the two disciplines.

b. For the institutions identified above, give the enrollments and degrees conferred within comparable program(s) for each of the last five years.

In each program listed below, the EE or ECE departments operate the CpE program, same as the proposed program. Enrollment statistics were not available for the separate programs (the students in EE and CpE were combined to give a department enrollment). Therefore, Table III below indicates the name of the department in which the computer engineering program resides and the enrollments in that department. Table IV indicates the break down between computer engineering and electrical engineering degrees. Thus, the separate enrollments can be inferred from the degrees awarded.

Table III. Enrollment in departments offering a CpE degrees

Institution Name	Year 1998	1999	2000	2001
Purdue	1046	1000	1053	1039
University of.Illinois - Urbana	no data	no data	1572	1618
Ohio State	no data	605	946	967
Virginia Tech	896	900	953	857
University of Alabama - Huntsville	372	390	415	427
University of Texas – Austin	1395	1475	1574	1598
Carnegie Mellon	478	489	470	453
Georgia Tech	1661	1659	1723	1636

Table IV. Degrees Awarded in departments offering a CpE degrees. For departments offering 2 degrees, the CpE degree is listed as the first number and the EE degree is listed second in parentheses.

Institution Name	Year of CpE degrees (EE degrees) 1998	1999	2000	2001
Purdue	69 (200)	84 (226)	75 (202)	115 (187)
University of Illinois - Urbana	no data	no data	132 (207)	137 (219)

Ohio State	no data	no data	86 (27)	95 (35)
Virginia Tech	70 (148)	101 (133)	121 (252)	157 (125)
University of Alabama - Huntsville	14 (51)	21 (47)	18 (44)	21 (51)
University of Texas – Austin	258	251	261	283
Carnegie Mellon	123	132	159	153
Georgia Tech	82 (239)	106 (235)	98 (223)	359 (224)

Tables III and IV indicate that all programs without exception show increasing degrees in CpE over these last 4 years. The average rate of increase in all programs with 2 degrees (excluding higher outliers for a more conservative estimate) is 19% per year. These data were collected from the statistics maintained by the American Society for Engineering Education.

3.04 Student Demand

a. Project the full-time headcount enrollment, the part-time headcount enrollment and the full-time equivalent enrollment of day students in the proposed program for the fall semester of each of the first five years.

Based on the statistics from the benchmark institutions and those presented in the in Section 1.02 b, it is estimated that the total enrollment in the undergraduate CpE degree program will grow from 110 to 220 over the first 5 years. In the first year most of the enrollment will come from students in the EE and CS programs. Since there is significant overlap between these programs and the proposed curriculum, we will likely see students in the proposed program at every level. Based on surveys of our current students and data at other institutions, it is estimated that about 70 to 120 students will move to the CpE degree program from the EE and CS degree programs. In addition, given the lack of competing programs in the state, the CpE at the University of Kentucky should grow at a rate approximately equal to or greater than those at benchmark institution. As Fig.3 show that current student enrollment in computer engineering programs is about double that of Electrical and Mechanical Engineering. So between a 19% growth rate as a conservative measure (based on benchmark institutions) and 50% increase as predicted by the national enrollment statistics, the anticipated enrollments are in Table V below based on an average 33% growth rate:.

Table V. Anticipated enrollments in the CpE degree program

Year				
2004	2005	2006	2007	2008
110	146	194	258	344

b. Repeat a. for evening students, if applicable.

N/A

c. Repeat a. for weekend students, if applicable.

N/A

d. Show how the above projections were determined.

The above estimates are based on:

1. **Anecdotal input from current students and student inquiring about the program at the University of Kentucky, and interest-area surveys of Freshman EE students**: A recent survey of EE freshman indicates approximately 43% are most interested in the CpE specialty area. 43% of our current EE enrollment comes to approximately 116 students. Given the additional students that may transfer from the CS program, 110 is a conservative number to start off with.
2. **Experience at other institutions:** Table IV shows a 19 % increase on average in degrees awarded from benchmark institutions.. Appendix I also provides case studies at other institutions. In addition the Fall 2001 enrollment of freshmen in Computer Engineering Programs nationally suggests a doubling of enrollment.

c. Estimate the number of students projected above who will be drawn from existing programs within the institution and the net increase in institutional enrollment in the fifth year of the program as a result of the program.

We estimate that, of the 344 students enrolled in the CpE degree program, approximately 2 fifths will come from the present ECE program, 1 fifth from the present CS program, and the 2 fifths will be the new students who would have otherwise gone to a different university. The net increase in institutional enrollment in the fifth year of the program as a result of the program will be approximately 137 students.

d. Project the number of graduates from the day program during each of the first five years.

It is estimated that the number of graduates from the program during the first 5 years will grow from 10 to 40 annually. Table VI indicates the projected number of graduate from the program over the first 5 years.

These numbers are based on the current ratio of enrolled students to annual graduates of the ECE department's EE program. With a 4 year delay between enrollments and graduates of the EE program, the average ratio between graduates and total enrollment for the last 5 years has averaged 18%. We expect some graduates after the first year (those whose electives in the current EE program matched for the most part the proposed curriculum). However, the 18% will not likely be realized until the third year.

Table VI. Anticipated graduates from the CpE degree program

Year				
2004	2005	2006	2007	2008
0	20	35	46	61

g. Repeat f. above for the evening programs, if applicable.

N/A

h. Repeat f. above for the weekend program, if applicable.

N/A

3.05 Evaluation Results of Related programs

a. If the proposed program relates to or articulates with an existing program within the institution, describe the process and results of the most recent evaluation of this related program, which may provide a base of support for the proposed program.

The proposed program articulates with the EE program and the CS program. The EE program, which resides in the ECE department, was successfully accredited 4 years ago by ABET for 6 years and has been continuously accredited since 1936. The ECE department will seek accreditation for this proposed CpE program.

The CS program at UK is currently not accredited by the engineering accreditation agency ABET. Such is the case for many quality CS program nationally

b. For programs, which prepare students for a specific occupation or profession, please present a summary of student follow-up data for graduates of related programs. A suggested format guide is provided in Form 1.

The CpE degree prepares students specifically for work as a computer engineer. For related programs (EE and CS) most students go directly into industry after earning a degree from this program and a small percentage (2 to 5%) go on for graduate school training. Many graduates have several offers before graduation and unemployment is rare (typically only under unusual circumstances). The last starting salary survey (May 2001) of our graduates indicated an average starting salary of $48,000 for CS graduates and $47,000 for EE graduates. Both numbers are consistent with national averages of starting salaries for graduates of similar programs. Therefore, both the CS and EE department have been graduating candidates who have been competitive in the job market.

3.06 Anticipated Issues/Trends

Describe current issues and anticipated trends, which provide a base of support for the proposed program.

Computer Engineering and digital technologies are the engines of growth for a modern day economy. Developments in these areas are transforming the very nature of the way the business is done in all walks of life including medicine, agriculture, science, engineering, education, entertainment, sports, and humanities. In addition, information technology, which is enhanced by advances in computer engineering, was identified as one of the five key areas in the Governor's New Economy initiative.

IV. RESOURCES REQUIRED

4.01 Facilities and Personnel

a. Facilities

1) Describe the facilities to be used for this program. If existing facilities are available, will they be temporary or permanent? If new facilities are required, describe renovation or construction plans. Include a statement of review by the facilities management or other facilities administrators indicating concurrence with the above description.

General Computing Laboratories

The University supports many general-purpose computing laboratories. These will be sufficient for the needs of computer engineering students. Should the Department of Computer Science move any courses to different computing facilities, CpE students would utilize the same facilities.

Faculty Offices

The hiring of additional faculty will require additional faculty offices. The opening of the Ralph G. Anderson Building has increased our ability to house faculty sufficiently to meet the anticipated additional needs for the proposed program.

Research Laboratories

Faculty sponsored research laboratories will be used for graduate, and some undergraduate projects and research. These laboratories will be tailored to the specific research interests of faculty. Currently laboratories are available in the areas of advanced networking, distributed computing, parallel processing, high-performance computing, computer vision and visualization, VLSI design and test, computer architecture, and embedded computing.

Digital Electronics Laboratories

Digital computing laboratories are required for EE281, EE/CS383, EE/CS499, and EE/CS583. Digital laboratories will require the minimum equipment listed in the following paragraphs.

The EE281 laboratory will be dedicated to this one course. Students will purchase a package of electronic components for use in the laboratory experiments. There will be an additional computer workstation that has a

logic programmer and printer installed and is connected to a projector. It will be used for laboratory demonstrations, student printing of designs, and burning chips. We anticipate that all ECE and CpE students, approximately 220 students per year will take the EE281 laboratory. Offering 6 sections (3 TAs) each semester would still allow for significant growth in the laboratory maintaining an efficient utilization of TA and faculty resources.

The laboratory would be equipped for 12 stations each having a development kit, oscilloscope, software, and PC. Additionally, the lab would be equipped with two logic analyzers, two logic programmers, one laser printer, a PC with software, and a projector. The total cost will be approximately $90,000.

EE/CS383 and 583 will initially share the same ten-workstation laboratory. Each workstation will have a signal generator, power supply, oscilloscope, 8052 development station, PC with software, and miscellaneous breadboards, connectors, and wires. The lab itself would also have three logic analyzers, two logic programmers, a projector, a PC with software, and a laser printer. The total cost is projected at $130,000.

Project Work Laboratories

Design and implementation of engineering projects is a critical component of the computer engineering educational process. Most undergraduates will gain this experience in EE/CS499 subtitled with a computer engineering topic. Projects will consist of the design and construction of computer-based electronic projects. Students require secure space in which to congregate with their peers and mentors and to maintain project hardware and test equipment. The details of this will vary from instructor to instructor but will require extended periods of time working at a reasonably equipped development lab workbench.

The envisioned development lab includes storage facilities to safely store student projects. Five student groups should be allowed to work on their projects concurrently. We believe equipment similar to that in the EE/CS383 and EE/CS583 laboratories will serve the students well. More space, per station, than the 383-583 lab will be required as the development teams will be larger, their projects will be larger, and they will have to store their models to allow others to use share the lab space. This laboratory will be equipped in a manner similar to that for EE/CS383 and EE/CS583 at a projected cost of $65,000.

2) Describe off-campus facilities (space, equipment, etc.) necessary for the program if applicable.

(none required)

b. Library

1) Provide a statement by the librarian concerning the availability of current and proposed library resources.

The Shaver Engineering Library can best be characterized as an engineering research collection that is capable of supporting advanced graduate and doctoral level programs in all the traditional engineering disciplines. The development of the library's collection of more than 80,000 volumes and 800 journal subscriptions has been in direct response to the teaching and research needs of the College of Engineering and its seven academic departments. With the rest of the UK Library System, the Shaver Library reaps the benefit of having the second largest library endowment among universities in the United States.

To support a computer engineering program, the Shaver Library provides access to several bibliographic databases, some including full-text access to documents, monographs and handbooks, and many major journal publications necessary for teaching and research in the field. Acquisition of additional monographic materials may be necessary for course specific reserves, but should be adequately supported by current collection development funding.

Databases provided include:

- ACM Digital Library. Includes full-text and citations from 1984-present for Computer Science journals & proceedings from the Association for Computing Machinery's publications.
- Cambridge Scientific Abstracts. Includes access to Computer and Information Systems Abstracts (1981-Present), Internet & Personal Computing Abstracts (1989-Present), and the National Technical Information Service's index to government sponsored research (1964-Present).
- Compendex. A multi-disciplinary engineering database. Coverage from 1970-present.
- IEEE ASPP and IEEE Online Conference POP. Provides full-text access to Institution of Electrical and Electronics Engineers' journal and proceedings publications from 1998-present.
- INSPEC. The index for Physics, Electrical & Electronics Engineering, Computer Science, and Information Technology. 1968-present.

For historical research in the field, earlier print versions of most of these databases are available.

Monographs and handbooks:

- The Shaver Library monograph collection is quite extensive in this area. However, additional purchases would no doubt be necessary to support course specific instruction and research.
- The Shaver Library has a large print handbook collection. This collection includes most of the major current handbooks produced in all fields of engineering covered by the College. Copies of the Computer Engineering Handbook, for example, are available in print and also electronically, via our subscription to the CRC Press' ENGnetBASE, which provides access to 126 engineering handbooks online.

Journals:

- The Shaver Engineering Library subscribes to approximately 800 serial titles in the engineering disciplines. The UK Library Systems' Online Journals Database has over 15,000 records for online journal titles, in all disciplines, which are available to students, faculty and staff.
- Specifically supporting Computer Engineering, the Shaver Engineering Library, maintains subscriptions to the ACM publications, the IEEE publications, some IEE (Institution of Electrical Engineers) and other publications that support this field. The major publishers and journals are certainly represented. Additional requests for journal titles would need to be ordered as recurring funding permitted.

In summary, the resources of the Shaver Engineering Library and the UK Library System should be easily capable of supporting research and teaching in this field. No problems are anticipated.

2) Compare holdings to standards/recommendations of national accrediting agencies, the Association of College and Research Libraries, and/or any other recognized measure of adequacy.

Library facilities appropriate to support a Research I graduate program in engineering and sciences is required. Adequate resources are available to start a computer-engineering program. In the future library acquisitions suggested by the Departments of Computer Science and Electrical and Computer Engineering will be made with consultation with faculty members participating in the Computer Engineering program.

c. Faculty

1) Submit by means of curriculum vitae (see Form 4) the qualifications of current ranked faculty members and adjunct

faculty who will launch the program. Indicate the percentage of time each will devote to the proposed program.

Table VII lists the CS and ECE faculty whose teaching DOE will cover part of the proposed CpE program. Since many of these courses overlap with current EE and CS degree requirements, many percentages are within current teaching responsibilities. Some percentages may represent temporary overload until new faculty are hired. A total of 27 sections per year can be covered by the faculty members listed below, in addition to a 12.5% administrative load for the Director of Undergraduate Studies.

Table VII. Faculty effort toward CpE program

Faculty Member	**Percent Effort to CpE Degree Program**
William Dieter (ECE)	37.5% (3 sections/year)
Hank Dietz (ECE)	37.5% (3 sections/year)
Kevin D. Donohue (ECE)	25% (1 section + DUGS/year)
Joseph Elias (ECE)	12.5% (1 section/year)
Robert Heath (ECE)	37.5% (3 sections/year)
Lawrence D. Holloway (ECE)	12.5% (1 sections/year)
James Lumpp (ECE)	37.5% (3 sections/year)
Bruce Walcott (ECE)	12.5% (1 sections/year)
Mukesh Singhal (CS)	12.5% (1 sections/year)
Anthony Baxter (CS)	25% (2 sections/year)
Kenneth L. Calvert (CS)	12.5% (1 section/year)
Zongming Fei (CS)	12.5% (1 section/year)
Raphael A. Finkel (CS)	12.5% (1 section/year)
James N. Griffioen (CS)	12.5% (1 section/year)
Jerzy Jaromczyk (CS)	25% (2 sections/year)
D. Manivannan (CS)	25% (2 sections/year)
Total:	**350% (28 sections/year)**

The curriculum vitae for each faculty member listed in Table VII with the information required by Form 4 are in Appendix III of this document.

2) Describe where and how non-ranked faculty (e.g., teaching assistants, and preceptors) will be utilized. Indicate the percentage of time each will devote to the proposed program.

Additional teaching assistants will be required especially as the enrollment grows. Their use will be consistent with their current usage in the CS and EE programs. It is expected that 9 new full-time TAs will be required for grading, supervising laboratory exercises, and teaching recitation sections. The additional TA's will cover sections of new and expanded courses in the CpE Curriculum. Table VIII indicates where the TAs will be placed in the additional courses/sections resulting from the CpE degree program.

Table VIII. TA usage in additional courses.

	Additional Resources Per Year		
	Sections	Instructors	TA
EE101 or CS101	0		0
CS-115	2	.25	.5
CS-215	2	.25	.5
CS-216	2		.5
EE-211	1		.25
EE-221	1		.25
EE-222	4	.5	1
CS-275	1		.5
EE-280	1		.5
EE-281	4		1
CS-315	1		.5
EE/CS-380	1		.5
EE/CS-383	3		.75
EE-421	1		.25
CS-441	1		.25
CS-470	1		.25
EE/CS-480	3		.75
EE-461	1		.25
EE-480	2		.5
EE/CS499	4		
Total:	**36**	**1**	**9**

3) **If additional faculty will be required immediately or in the next five years, indicate the number and submit specific qualifications for each new faculty member. Discuss recruitment potential.**

The faculty will formally be members of either the ECE or CS departments, and therefore qualifications commensurate with these departments are required (Ph.D. in Electrical Engineering, Computer Engineering, or Computer Science). The department chairs will use the distribution of effort agreements to detail the degree of involvement by each faculty member to the program. We anticipate that approximately 4 additional new faculty in CS and ECE will be required to regularly provide all the courses in the core of the CpE program and expand the senior-level courses (electives for the CpE students) and graduate courses. The CS, ECE and CpE students will jointly subscribe to many of the course offerings, especially in the freshman and sophomore years. The current faculty members in both departments should be able to manage for the first few years with limited overload assignments. Based on the predicted enrollment increases, additional sections at the 200-, 300, and 400-level courses will be required (as shown in Table VII). Also, the current 500-level electives related to CpE often fill up quickly and students are turned away. These courses will have to be offered every semester once the CpE program is running at 100%. Therefore, it is expected that 2 new faculty lines in ECE and 2 new faculty lines in CS will be required over the next 4 years to expand the senior elective level offering. These faculty members should have an emphasis in computer engineering or related areas.

While it is difficult to hire in these areas because of competition from other schools, the ECE and CS department have had reasonable success in hiring computer engineering faculty (about 1 every 2 years in each department). The existence of the CpE program will enhance our ability to hire faculty working in core areas of CpE. Therefore, it is expected that with consistent effort over the next 5 years qualified faculty can be recruited to fill these lines.

4.02 Expenditures

Present all anticipated program expenditures for the next four years on Form 2. Use FORM 2A to provide a rationale for the expenditure data.

Recurring Personnel Costs:

The CpE Program will require an additional 8 course offerings per year by faculty (this includes additional senior level electives and senior design courses), an additional 8 by instructors, and 9 FTE TAs. We believe that we will need at least 4 additional courses offered at the graduate level to sustain a new program. This requires a total of 20 additional course offerings per year. Assuming an average of 3 courses per year for new and research-active faculty, we will need 8 courses from an instructor (8/8 = 1 instructor) and 12 courses by faculty (12/3 = 4 faculty).

The estimated recurring costs for four faculty members, an instructor, and 9 teaching assistants, a technician, and an additional staff member will be approximately $660,000 per year.

Recurring Operating Costs:

Equipment maintenance and upgrades, supplies, travel, and telephone are estimated at $135,00 per year. Recurring Operating funds will be equitably shared between CS and ECE.

Start-up Costs:

Faculty startup costs will be required as consistent with packages offered to new faculty in ECE and CS. Also, start up funds will be needed for laboratory upgrades. Total start up costs are estimated at $ 310, 000.

FORM 2

Departmental Expenditures for the Program (Academic Year)

		YEAR 1	YEAR 2	YEAR 3	YEAR 4
I.	**Personnel**				
1.	Full-time ranked faculty (FTRF)				
	a. Number of FTEF***	2.00	4.00	4.00	4.00
	b. Average salary	70,000.00	73,000.00	76,100.00	79,100.00
	c. Fringes per average salary	14,000.00	14,600.00	15,200.00	15,800.00
	Cost of FTEF: a x (b+c)	168,000.00	350,400.00	365,200.00	379,600.00
2.	Part-time faculty (PTF)				
	a. Course credit hours taught by PTF				
	b. Average PTF salary per credit hour				
	c. Average PTF fringes per credit hour				
	Cost of PTF: a x (b+c)	0.00	0.00	0.00	0.00
3.	Teaching assistants (TA)				
	a. Course credit/contact hours taught by TA	2,880.00	4,320.00	5,760.00	5,769.00
	b. Average TA salary per hour	20.00	20.75	21.25	22.00
	c. Average TA fringes per hour	2.00	2.10	2.13	2.20
	Cost of TA: a x (b+c)	63,360.00	98,712.00	134,668.80	139,609.80
4.	External instructional assistants (EIA) (Preceptors, etc.)				
	a. Student contact hours				
	b. Average EIA fee				
	Cost of EIA	0.00	0.00	0.00	0.00
5.	Other (specify)*				

Categories (e.g., secy.)	% full-time	rate				
Instructor	100.00	55,000.00	55,000.00	56,500.00	58,000.00	59,500.00
Staff Assistant II	100.00	22,000.00	22,000.00	23,600.00	24,300.00	25,000.00
Technician	100.00	51,500.00	51,500.00	53,000.00	55,500.00	57,000.00
Cost of other			128,500.00	133,100.00	137,800.00	141,500.00
TOTAL PERSONNEL COSTS			359,860.00	582,212.00	637,668.80	660,709.80

		YEAR 1	YEAR 2	YEAR 3	YEAR 4
II.	**Operating costs***				
1.	Supplies	40,000.00	45,000.00	50,000.00	50,300.00
2.	Travel	2,000.00	3,000.00	4,000.00	4,000.00
3.	Library**				
	Department Budget				
	a. journals				
	b. books				
	c. other (specify)				
4.	Student support (assistantships, fellowships, tuition waiver)				
5.	Equipment**				
	a. instructional	220,000.00	50,000.00	70,000.00	80,000.00
	b. research	155,000.00	155,000.00		
	c. other				
6.	Off-campus facilities				
7.	Accreditation				
8	Other (specify)				
	Total Operating costs	417,000.00	253,000.00	124,000.00	134,300.00
III.	**Capital Costs***				
1.	Facilities				
	a. new construction				
	b. renovation				
	c. furnishings				
2	Other (specify)				
	Total Capital costs	0.00	0.00	0.00	0.00
	TOTAL EXPENDITURES	776,860.00	835,212.00	761,668.80	795,009.80

*If the department will operate programs other than the proposed program, use the ration of the projected student credit hours generated within the department by the program to the student credit hours generated by the department to allocate costs to the proposed program when it is otherwise difficult or impossible to allocate the programs' responsibility for the cost. If such a ratio is used, enter its value here , and identify items to which it is applied with an asterisk.
**Insert here the annual portion of the departmental budget set aside for this item of the program. Extraordinary or special purchases beyond the regular or continuing line item should be recorded in III.2.
***Show how FTEF is calculated on FORM 2A.

FORM 2A

BUDGET JUSTIFICATION

A rationale should be provided for all costs recorded on FORM 2. If explanation of an expenditure is contained elsewhere in the proposal, it is necessary only to record on this form the section in which it appears.

Initial equipment costs are explained in Section 4.01a (Facilities)

Recurring personnel, operating, and onetime startup costs for new faculty are explained in Section 4.02 (Expenditures)

4.03 Source of Revenues

a. Using FORM 3, specify the amount of revenues for the program from each source.

b. If applicable, provide evidence of institutional intent to maintain the program as described herein when grant or other outside funds are terminated.

We anticipate that laboratories can initially be funded by solicited donations from alumni, industry, and the NSF. Recurring funding will be sought from the University and private endowments. With an anticipated 90 new students added to the program, approximately $350,000 of tuition will be generated every year. An additional $400,000 in recurring cost will be required from the University/State. A significant portion of faculty startup costs can be generated from accumulating funds in vacant faculty lines.

FORM 3

AMOUNT AND SOURCES OF REVENUE

		YEAR 1	YEAR 2	YEAR 3	YEAR 4
1.	Regular state appropriation and tuition and fees				
	a. New money	660,000.00	710,000.00	795,000.00	795,000.00
	b. Internal reallocation*	0.00	0.00	0.00	0.00
2.	Institutional allocation from restricted endowment				
3.	Institutional allocation from unrestricted endowment				
4.	Gifts	100,000.00	200,000.00		
5.	Extraordinary state appropriation				
6.	Grants or contracts**				
	a. Private sector				
	b. Local government				
	c. State				
	d. Federal				
	e. Other				
7.	Capitation				
8.	Capital				
9.	Other (specify)				
TOTAL REVENUES		760,000.00	910,000.00	795,000.00	795,000.00

*If revenue will be provided through reallocation within the university, explain in detail how this will be done.

**Name funding source and specify funding period.

Appendix I
Impact on enrollments when a Computer Engineering program is added

From an informal survey of Electrical and Computer Engineering Department Chairs, the following trends in enrollments were observed.

a. The introduction of Computer Engineering program helped stabilize or increase the total enrollment (the sum of EE + CpE) over the last decade.
b. In the absence of Computer Engineering program, the EE enrollments at most of the universities decreased substantially over the last decade.
c. After the introduction of the Computer Engineering program, CpE enrollments grew steadily while the EE enrollments decreased a little or were stable.

Some case studies are described below:

Case Study 1: University of Virginia*

The Electrical Engineering Department at the University of Virginia has had a digital systems concentration within its Electrical Engineering degree program for a numbers of years. Approximately four years ago, Electrical Engineering defined a Computer Engineering option which would satisfy the ABET criteria for an accredited program in Computer Engineering. The initial direction of this effort was to provide an opportunity for the students within Electrical Engineering interested in computer related issues to obtain an Electrical Engineering degree while also satisfying a Computer Engineering program.

As shown in Fig. I.1, the Electrical Engineering degree program has grown over the past few years, in part because of the existence of the Computer Engineering option. It is anticipated that approximately 50 percent of the enrollment will be new to the institution and 50 percent will be migration form the other programs. Relative to the migration process, it is anticipated that 75 percent will migrate from the Electrical Engineering program, 15 percent from the Computer Science program, and ten percent from the systems engineering program.

The significant transfer of students from the Electrical Engineering program should not be viewed as a detriment since these are students who would have chosen the Computer Engineering concentration within the Electrical Engineering program and would have chosen those classes from the same professors.

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* For this information, the author is grateful to Dr. James Aylor, Louis T. Rader, Professor and Chair, ECE Dept., University of Virginia.

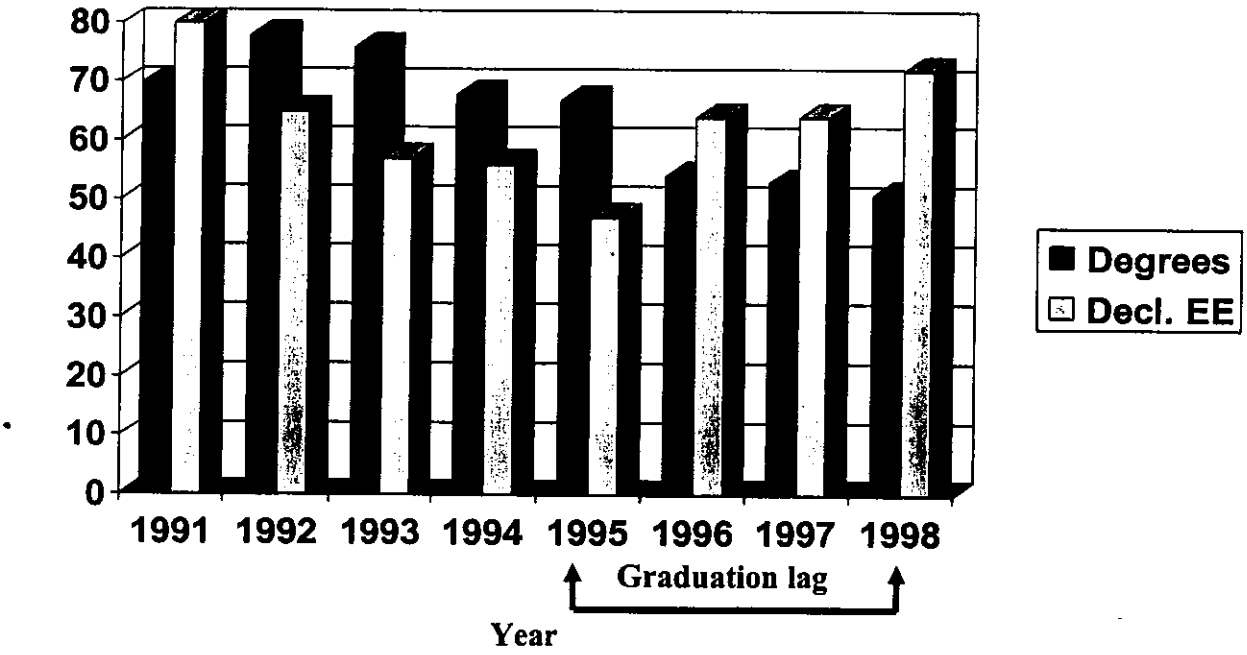

Figure I.1. Annual EE Degree Production and New Student Declaration

As shown in Fig. I.2, the growth of the programs within the School in the general area of information technology has grown significantly over the past several years. These programs represent over 65 percent of all of the students in the

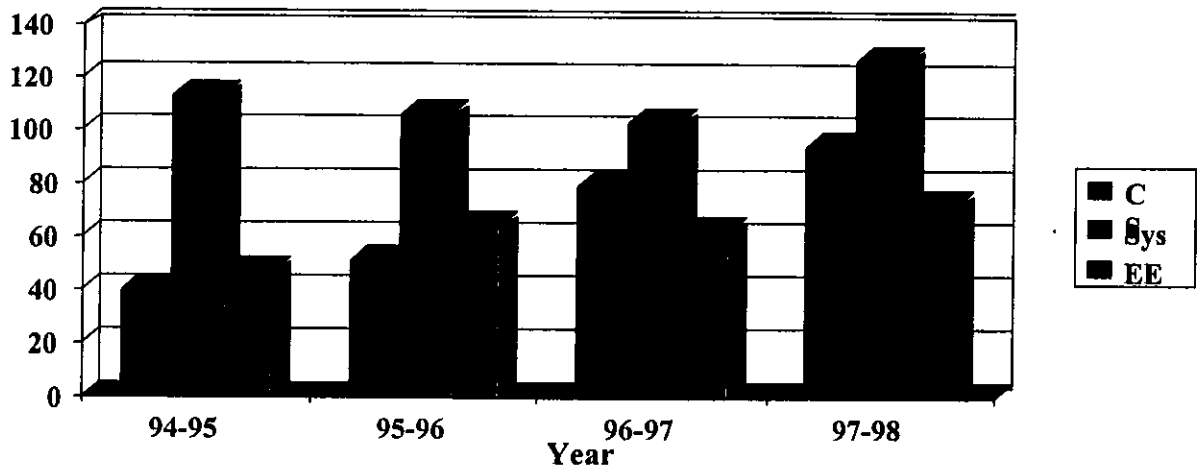

Figure I.2. New Student Growth in IT Areas

School.

The estimate of the program growth is shown in Table I.1.

1	40	20
2	50	30
3	60	40
4	60	50
5	60	50

Case Study 2: Rose-Hulman Institute of Technology*

Enrolment Data for the ECE Department at Rose-Hulman Institute of Technology

Year	EE	CPE
1990-1991	258	45
1991-1992	253	64
1992-1993	253	46
1993-1994	238	52
1994-1995	234	59
1995-1996	235	82
1996-1997	206	109
1997-1998	218	143
1998-1999	203	187
1999-2000	205	159
2000-2001	213	174

It should be noted that over the 10 year period between 1990 and 2000, the total enrollment in EE and CPE programs increased 28% from 303 to 387).

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* For this information, the author is grateful to Dr. Fred Berry, Chair, ECE Dept., Rose Hullman Institute.

Appendix II

Computer Engineering Program Committee Report

University of Kentucky
College of Engineering

Proposal for the establishment of a Computer Engineering Program

1 Introduction

1.1 Computer Engineering Program Committee Charge

The chairs of Computer Science and Electrical and Computer Engineering along with the dean of the college of engineering are considering the establishment of a computer-engineering program to:

- better meet the demands of state and national industry,
- better serve the computer related professions,
- enhance the research opportunities and collaborations between the Electrical and Computer Engineering and Computer Science programs.

In order to realize this goal, the Electrical and Computer Engineering and Computer Science departments established a committee with the following charge:

1. Research other national computer engineering programs (BS, MS, and PhD) to understand the variety and similarity between programs that are currently being offered. This would include details on the administrative arrangements for the programs and curriculum content.
2. Recommend an approach for establishing a computer-engineering program that will be feasible and well suited for the University of Kentucky (i.e. one that would have faculty, student, and local industry support and consistent with university policies and regulations). Recommendations should include a tentative timetable for the official establishment of the program.
3. Determine required resources for associated laboratory support for recommended program: equipment, faculty, teaching assistants, support staff, and space for laboratories and personnel.
4. Identify specific research focus areas related to the computer-engineering program to help guide future hiring of professors and creations of new positions.

1.2 The Committee

A committee consisted of:

Prof. Anthony Q. Baxter, CS
Mr. John Bender, Lexmark International, Inc
Mr. John Brown, Lexmark International, Inc
Prof. Kenneth L. Calvert, CS
Prof. Henry G. Dietz, ECE
Prof. Raphael A. Finkel, CS
Mr. Michael E. Lhamon, Lexmark International, Inc
Prof. James E. Lumpp, Jr., ECE
Prof. Charles E. Stroud, ECE

1.3 Recommendation

We propose the establishment of degree programs in Computer Engineering at the bachelor, master's and doctoral levels. The program is to be jointly and equally administered by the Department of Computer Science and the Department of Computer and Electrical Engineering.
This proposal details the proposed:

- program objectives and benefits to the Commonwealth of Kentucky,
- academic programs,
- and resource requirements.

2 Mission, Influence, Organization

2.1 What is Computer Engineering?

The Computer Engineering (CEN) program includes courses dealing with the design, implementation, fabrication, and analysis of computer controlled devices and digital electronics. A foundation of continuous and discrete mathematics, natural sciences, programming, digital logic, and circuits is used to study algorithms realized in computer software and hardware. Through required and elective courses students are exposed to integrated circuit design, operating systems, computer architecture, graphics, visualization, artificial intelligence, microelectronics, networks, databases, robotics, and digital communications.

2.2 Computer Engineering Mission

The mission of the Computer Engineering program is to be the flagship Computer Engineering program in the Commonwealth of Kentucky by:

- providing the highest quality undergraduate and graduate education in a state-of-the-art engineering and computing environment and by preparing students for careers in academia and in the computer and digital electronics industry;
- advancing theoretical and experimental knowledge in the computer engineering area through cutting-edge research by faculty and students; and
- promoting computer engineering as a means to improve productivity in industry by actively participating in the technology transfer process.

2.2.1 The Undergraduate Program

Goals and objectives for the undergraduate computer-engineering program are found in Appendix II-A.

2.2.2 The Graduate Program

Goals and objectives for the graduate computer-engineering program are found in Appendix II-B.

2.3 Consistency with Mission

2.3.1 Consistency with the University Mission

The goals of the proposed Computer Engineering Programs are consistent with the educational mission of the University as a whole. They serve the Commonwealth by providing highly trained technically oriented engineers who will be competitive in the job market.

2.3.2 Consistency with the College Mission

The College mission statement and vision statements are:

Mission Statement

To provide education, research, and service in a scholarly environment in a way that:

- prepares our students for successful professional career;
- addresses the changing needs of our other constituents; and
- responds to the technological challenges facing the Commonwealth and the nation.

Vision Statement

We aspire to make the College of Engineering one of the nation's great engineering schools, recognized nationally and internationally for excellence in teaching, research, and public service. We seek to be the preferred choice of students and practitioners seeking an engineering education, employers hiring engineering graduates, and organizations seeking advanced engineering knowledge.

The addition of a computer-engineering program to the College is consistent with its mission and vision.

3 Program Descriptions

3.1 The Undergraduate Degree Program

3.1.1 Admissions

3.1.1.1 Admissions to the Pre-Engineering

All undergraduate students at the University are eligible to declare Computer Engineering as their major.

3.1.1.2 Admissions to Engineering Standing

- Students will be admitted to Engineering Standing in Computer Engineering upon attaining a grade point average (gpa) of 2.5 in the following courses: CEN-100, MA-113, MA-114, Phy-231, Phy-232, CEN-280, CEN-281, CS-115, CS-215, and ECE-2111.

3.1.2 Curriculum for BS

The following table lists the required courses for the BS in Computer engineering. A total of 132 credit hours are consistent with other programs in the College. Unless noted otherwise the CEN courses listed below are, with minor changes, existing Computer Science or Electrical and Computer Engineering courses. In this document they are listed as being CEN but they could also be cross-listed CEN/CS or CEN/ECE or CEN/CS/ECE courses. Course descriptions for CEN courses can be found in Appendix II-G.

Computer Engineering BS Degree Requirements		
ENG~~101-102~~ 104	English Composition 1 & 2	~~6~~ 4
CEN-100	Computer Engineering Profession [NEW]	1
	USP Humanities	6
	USP Social & Behavioral Sciences	6
	USP Communications [*could be done partially within CEN*]	3
	USP Cross Cultural	3
	USP Cross Disciplinary [*may be eliminated or modified by the University Senate*]	3
MA113, MA114, MA213, MA214	Calculus I, II, III, and IV	15
STA381	Engineering Statistics	3
PHY231, PHY232, PHY241, PHY242	University Physics I and II University Physics Laboratory I and II	10
CHE105	General Chemistry I	3
CS115	Introduction to Computer Programming	3
CS215	Introduction to Program Design, Abstraction, and Problem Solving	4
CEN216	Introduction to Software Engineering	3
ECE211, ECE221 and ECE222	Circuits I & II with Laboratory	9
CS275	Discrete Mathematics	4
CS315	Algorithm Design and Analysis	3
CEN280	Design of Logic Circuits	3
CEN281	Logical Design Laboratory [NEW]	2
CEN380	Computer Architecture	3

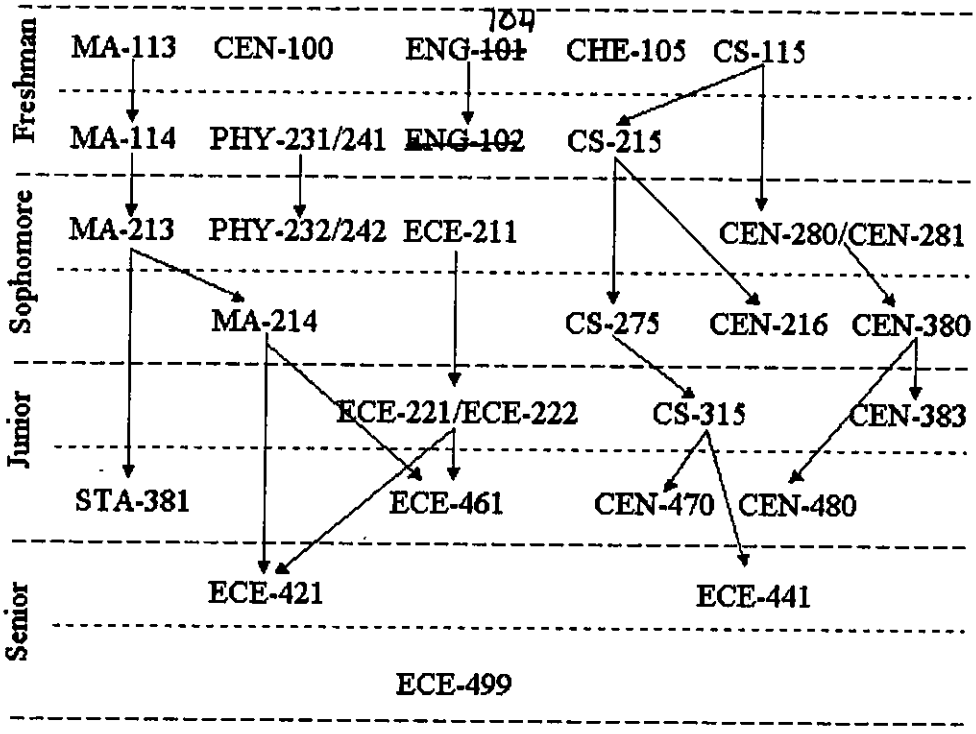
CEN480	Advanced Computer Architecture [NEW]	3
CEN383	Microprocessors/Embedded Systems [NEW]	
ECE421	Signals & Systems I	3
ECE461	Introduction to Electronics	3
CEN441	Compilers for Algorithmic Languages	3
CEN470	Operating Systems	3
CEN499	Senior Design Project [NEW]	3
Technical	Technical Electives	12
Supportive	Supportive (free) Electives	6
	Total Required	~~132~~ 130

Below is a diagram of the required classes in the program.

Observe that all courses taken in the first year are common to all of the programs in the college. In the second year the program remains very close to both ECE and CS with at most two classes (CS-275 and ECE-211) not being required courses in the other program. This allows students to spend the first two years before being required to select between ECE, CS and CEN.

You will note that there is considerable flexibility in the junior and senior years. This allows some slack in specified courses and for completion of technical and supportive electives.

"One of the humanities electives or the cross-cultural elective should be selected to also fulfill the graduation writing requirement."



3.2 *The Graduate Degree Programs*

3.2.1 Admissions

3.2.1.1 Admissions through University Scholars Program

The regulations can be found in the University Bulletin. Here are only the most important facts. Applicant to the program must meet the following requirements:

1. Must have senior standing (completed ≥90 credit hours) and have completed all University Studies requirements.
2. Should apply at the end of the junior year.
3. Must have GPA of at least 3.2 and 3.5 (the latter in CS courses).
4. Follow the current applications for the Graduate School, e.g., have taken GRE.

Additionally,

2. The current undergraduate advisor will also serve as the graduate advisor until MS project/thesis advisor is chosen.
3. In special cases, we could petition for postponing the fulfillment of some requirements. E.g., for an applicant without GRE taken, we could petition for the provisional admission.
4. Once admitted to USP, a student enjoys the privileges of graduate students, e.g., can be a TA or RA.
5. To apply, each student has to have a jointly planned program of study both for BS and MS. To help you in future preparation of the study program, a sample is available from the DGS in Computer Engineering.

Recall that the undergraduate curriculum in CEN requires 132 hours of course work. The Master's program under Plan A requires 24 graduate credit hours, and under Plan B 30 credit hours. Students in

USP are permitted to have up to 12 graduate credit hours counted towards both BS and MS. That is, under Plan A, they would be required to complete at least 144 credit hours,

3.2.1.2 Admissions to MS and PhD Programs

Graduate applicants will be subject to the Graduate School admissions criteria. Those acceptable to the Graduate School will be accepted as space permits. The Director of Graduate Studies in the Computer Engineering program is changed with admitting the strongest student applicants in the applicant pool.

3.2.2 The Graduate Curriculum

In order to assure a minimum breadth and level of understanding at the graduate level the Computer Engineering Program requires that students take certain prescribed courses representing the major areas of computer engineering. All students regardless of their graduate program status (MSCEN or Ph.D.) must fulfill this requirement. Students must pass the following six courses.

CS-515	Algorithm Design
CEN-570	Modern Operating Systems
CEN-690	Advanced Operating Systems
ECE-583	Microprocessors
CEN-685	Digital Computer Structure
CEN-686	Advanced Computer Architecture Design

Additional courses can be selected from CEN courses and from listed CS and ECE courses. The currently approved CS and ECE courses include the following:

CS 521	Computational Sciences
CS-535	Intermediate Computer Graphics
CS-541	Advanced Compiler Design I
CS/ECE-587	Microcomputer Systems Design
CS/ECE-635	Image Processing
CS-636	Computer Vision
CS-641	Advanced Compiler Design II
CS/ECE-642	Discrete Event Systems
CS-645	Computer Networks
CS-655	Design of Programming Languages
CS-676	Parallel Algorithms
CS-679	Advanced Graph Algorithms
CS/ECE-682	Switching Theory
CS/ECE-683	Finite State Machines
CS/ECE-688	Neural Networks
ECE-511	Introduction to Communication Systems
ECE-512	Digital Communication Systems
ECE-527	Electromagnetic Compatibility
ECE-530	Robotics
ECE-564	Digital Electronic Circuits.
ECE/MSE-566	Hybrid Microelectronics
ECE/MSE-569	Electronic Packaging Systems and Manufacturing Processes
ECE-568	Fiber Optics
ECE-571	Feedback Control Design
ECE-581	Advanced Logical Design
ECE-582	Hardware Description Languages and Programmable Logic
ECE-584	Introduction of VLSI Design and Testing
ECE-585	Fault Tolerant Computing
ECE-586	Communications and Switching Networks
ECE-605	Systems for Factory Information and Control

ECE-611	Deterministic Systems
ECE-612	Computational Aspects of Robotics
ECE-613	Optimal Control Theory
ECE-630	Digital Signal Processing
ECE-640	Stochastic Systems
ECE-684	Introduction to Computer Aided Design of VLSI Circuits

3.2.2.1 Additional MS requirements

Students can graduate with a master's degree in Computer Engineering using either Plan A (Thesis Option) or Plan B (Non-Thesis Option). All graduate students must complete at least half of their graduate courses at the 600-level or higher.

3.2.2.1.1 MSCEN - Thesis Option

Plan A, the thesis option, requires the completion of twenty-four hours of graduate credit, conducting a research project, and writing a thesis.

3.2.2.1.2 MSCEN - Non-Thesis Option

Students pursuing their MSCEN degree by Plan B, the non-thesis option, are required to complete 30 hours of acceptable graduate course work plus three credit hours of CEN-784 - Research Project in Computer Engineering.

TheCEN-784 research project need not be as extensive as a thesis. The scope of work of the MSCEN project and its content is left to the discretion of the student's academic advisor. The project must be typed but need not be typed in the specific Graduate School format required of a thesis. A copy of the project is to be submitted to the CEN Program before approval of the final examination is given.

3.2.2.2 Final Examinations for MSCEN Degrees

A final examination is administered to all MSCEN candidates. This examination may be oral, written, or both as determined by the student's academic advisory committee. The Director of Graduate Studies and the U.K. Graduate School must approve of the student's examining committee. The examination must be scheduled in the manner approved by the Graduate School.

Should the student fail the final examination, the examining committee must recommend to the Graduate Council the conditions under which a second examination may be administered. A majority opinion rules in all decisions. A split decision results in the student's failure. A third final examination is prohibited.

3.2.3 PhD

Persons wishing to obtain a Ph.D. degree in Computer Engineering must demonstrate original scholarship and research in the overall field. Although no formal University course requirements exist for the Ph.D. program, students must satisfy the previously mentioned CEN core course requirements in addition to all other course work determined necessary and appropriate by the student's Advisory Committee. Each student must satisfy the residency requirement set forth in the Graduate School Bulletin and elsewhere in the Computer Engineering Graduate Handbook. The student must also select an academic advisor and formulate a graduate plan of study requiring the approval of the CEN Director of Graduate Studies.

3.2.3.1 Major Professor and Advisory Committee

The Director of Graduate Studies will initially serve as a student's academic advisor. The student's full Advisory Committee, including a major professor, is to be chosen no later than one year prior to the taking of the Qualifying Examination. This Committee, along with the major professor who serves as the Chair of the committee, guides the student, determines his/her doctoral course work, and sets specific requirements to be followed in order for the student to obtain his/her degree.

The student's major professor as well as two other members of his/her Advisory Committee must be a faculty member in Computer Science or Electrical and Computer Engineering Departments. The Director of Graduate Studies in accordance with the rules of the Graduate School recommends advisory committees.

3.2.4 The Qualifying Examination

All doctoral students are required to pass a qualifying examination before being admitted to doctoral candidacy. The exam is administered by the student's Advisory Committee and consists of both written and oral sections. Majority approval of the Advisory Committee is necessary for the student to pass the examination. The examination must be scheduled through the Director of Graduate Studies and the UK Graduate School.

3.2.4.1 The Dissertation

All doctoral candidates are to conduct a major research project, the result of which culminates in written form as a dissertation. This dissertation must be a well-reasoned, original contribution to the knowledge and field of Computer Engineering and must show evidence of scholarly attainment in the student's particular area within the general discipline. The dissertation must be typed according to the format specified in the handout "Instructions for the Preparation of Theses and Dissertations" available from the U.K. Graduate School.

3.2.4.2 Final Examination for Doctoral Candidates

A request for Final Examination form should be submitted to the Graduate Dean along with the signed Dissertation Approval sheet no later than four weeks prior to the scheduled final exam. A complete, typed copy of the dissertation must be submitted along with these two forms. A complete copy of the dissertation includes a title page, abstract, all figures, tables, appendices, references, etc.

The final examination is a public event. Any member of the university community may attend. The final examination includes a defense of the dissertation. The content of the final examination is left to the discretion of the Advisory Committee.

After the final examination is successfully passed, the final copy of the dissertation is prepared and sent to the U.K. Graduate School.

3.3 Administrative Structure

Major features of the administrative structure of this program are as follows:

1. The teaching and research faculty of the Computer Engineering Program will be drawn from the Electrical and Computer Engineering (ECE) Department and the Computer Science (CS) Department in the College of Engineering at UK.
2. All faculty of the Computer Engineering Program will hold joint appointments in the CS and ECE departments. Each faculty will have a "primary" department where they will be evaluated and granted promotion and tenure when appropriate.
3. The ECE chair will be responsible for the day-to-day operation of the program. However important decisions about the program require consultation with the CS chair. The CS chair will make the determination of which issues and decisions are to be categorized as "important."
4. Director of Undergraduate Studies (DUGS) and a Director of Graduate Studies (DGS) for the Computer Engineering program will be appointed. One of these directors will come from the ECE Department and the other from the CS Department. Formally, the Dean of the College of Engineering appoints the DUGS and the Dean of the Graduate School appoints the DGS. For day-to-day administrative matters they will report to the ECE chair.
5. All resources, revenues and expenses relating to the Computer Engineering Program will be shared half and half between the ECE and the CS Departments.

6. CEN students will be enrolled in the ECE department. However, all resources and expenses related to the credit hours taken by these students will be shared equally between the ECE and CS Departments.
7. The CS and ECE departments will be committed to bearing a 50% share the teaching loads, TAs, labs, etc. for the Computer Engineering Program. To illustrate the equality of the ECE and CS Departments in the execution of the program, the CS department chair and the ECE department chair will share the handing out of the Computer Engineering degrees at the commencement ceremonies.
8. The ECE department will apply for, and secure ABET accreditation for the Computer Engineering Degree.

3.4 Accreditation/Certification

The program in Computer Engineering will apply for accreditation by ABET at the earliest possible opportunity.

3.5 Objectives/Evaluation Scheme

3.5.1 Program objectives and evaluation planned for the program.

Appendix II-C details the evaluation proposed for the undergraduate program and Appendix II-D does the same for the graduate program.

3.5.2 Competencies the student will have upon completion of the program and how they will be evaluated

Graduates of the Computer Engineering program will:

- acquire a foundation of continuous and discrete mathematics, natural sciences, programming, and digital logic, and electronic circuits,
- be knowledgeable about algorithms realized in computer software and hardware,
- be exposed to integrated circuit design, operating systems, computer architecture, microelectronics, compiling, and digital communications,
- gain experience designing, implementing, fabricating, and analyzing computer controlled devices, embedded systems, and digital electronics,
- have had the option to acquire technical skills in additional topic areas such as: databases, VLSI, graphics, image processing, networks, communications, visualization, artificial intelligence, robotics, and control theory.

3.6 Advisory Committee

Currently, the College of Engineering and Computer Science have industrial advisory groups. This proposal has been discussed with these groups. The department of Electrical and Computer Engineering is in the process of establishing a group. In the future the Computer Science and Electrical and Computer Engineering advisory groups will be periodically advised of the activities in the Computer Engineering program and their council will be solicited. The College Advisory committee will participate at the pleasure of the Dean. We do not anticipate the immediate need to form a separate advisory committee.

3.7 Plans for Articulation/Transfer Cooperation

The College of Engineering has procedures for establishment and periodic review of articulation and transfer agreements. The Computer Engineering program will follow these procedures.

4 Supportive Data

4.1 Personnel Requirements

The proposed program in Computer Engineering will minimally require the following personnel. Twelve (12) fte teaching faculty, ten-twelve (10-12) fte graduate assistants, one (1) staff technician, and one (1) clerical staff person.

We envision that the Departments of Computer Science and Electrical and Computer Engineering will each, through their normal teaching loads, supply approximately 4 fte instructional faculty. Many of the courses to be offered in the proposed computer-engineering program will be courses required by students in CS and ECE. Computer engineering students will tend to inflate the class sizes somewhat. These increases will be offset by some CEN TA support and by anticipated shifts in demand for courses.

Some courses are required for CEN majors only. These courses are ones not currently offered and represent a demand for additional resources. We require a minimum of four (4) additional faculty to equitably share the burden of extra classroom duties associated with the CEN Program. The details of this can be found in Appendix II-F.

4.2 Similar Programs in Kentucky

Only the University of Louisville and the University of Kentucky offer significant engineering programs. Currently, neither the University of Louisville nor the University of Kentucky offers programs similar to those that we propose.

4.2.1 University of Louisville, Speed Scientific School

The Electrical and Computer Engineering Department offer the following degrees:

Bachelor of Science degrees in Electrical and Computer Engineering degree (BSECE)
Master of Engineering degree (MENG)
Doctor of Philosophy (Ph.D.) Degree in Computer Science and Engineering (CSE)
Doctor of Philosophy (Ph.D.) Degree in Electrical and Computer Engineering.

4.2.2 UK College of Engineering

UK currently offers degrees in Computer Science and Electrical and Computer Engineering at the baccalaureate, masters and doctoral level. There is currently no competing program at the University of Kentucky.

4.3 Comparative Programs in Other States

We have studied programs at the following universities: Purdue, Illinois, Carnegie-Melon, Georgia Tech, Ohio State, Virginia Tech, University of Alabama - Hunstville, Stanford, and the University of Texas - Austin.

Most of the programs appear to have a distinctive "flavor" depending on the sponsoring department. In schools where the program grew out of an electrical engineering program there appears to the committee to typically be a dearth of computer science material. In programs sponsored by Computer Science the opposite is true, namely, there appears to us to be insufficient foundational education in basic electrical engineering.

We believe that this proposal strikes the appropriate balance between the two disciplines.

4.4 Student Demand

Expected student demand has proven very hard to predict with any great degree of confidence. Anecdotal evidence suggests that when computer-engineering programs have been established a significant number of majors (often approaching 50%) in the sponsoring department will elect computer engineering. This is not surprising as in all instances we found the proposed major was very similar to an existing computer science or an existing electrical engineering major.

We are proposing a program that falls more centrally between CS and ECE than do the programs we have investigated. Thus we hope that we will attract students equally from both CS and ECE.

Additionally, we hope to attract some students who would not attend UK were this program not established. We estimate that approximately 40% of the present ECE, 15% of the current CS, and 25 new incoming students will elect the program.

Spring 2001	CS	ECE	CmP estimate
pre-Engineering	296	151	120
Engineering Standing	172	106	85
Total	468	257	170

For the purposes of this proposal we have assumed that that each year we will attract approximately 100 computer-engineering majors. We further assume that 45 would have been CS majors, 60 would have been ECE majors, and 25 new students will matriculate only because CEN is available. This cadre of 120 students less attrition plus incoming transfer students will become approximately 85 engineering standing students.

The graduate program enrollments will be more manageable as the admissions process can be tightly controlled. We anticipate that we will attract students away from CS and ECE and most courses germane to CEN will continue to be heavily subscribed. For enrollment projections, see Appendix II-E.

5 Resources

This section details the needed resources to implement a competitive Computer Engineering program in the current environment at UK. We detail the incremental costs needed to implement the program. The next major section addresses the current availability of some of the resources to be used in the program and details additional resources needed maintain the proposed program.

5.1 Facilities

5.1.1 General Computing Laboratories

The University supports many general-purpose computing laboratories. These will be sufficient for the needs of computer engineering students. Should the Department of Computer Science move any courses to different computing facilities, computer-engineering students would utilize the same facilities.

5.1.2 Faculty Offices

The hiring of additional faculty will require additional faculty offices.

5.1.3 Research Laboratories

Faculty sponsored research laboratories will be used for graduate, and some undergraduate projects and research. These laboratories will be tailored to the specific research interests of faculty. Currently laboratories are available in the areas of advanced networking, distributed computing, parallel processing, high-performance computing, computer vision and visualization, VLSI design and test, and computer architecture.

5.1.4 Digital Electronics Laboratories

Digital computing laboratories are required for CEN-281, CEN-383, CEN-499, and CEN-583. Digital laboratories will be require the minimally equipment shown in the tables below. The CEN-281 laboratory will be dedicated to this one course. Students will purchase a package of electronic components for use in the laboratory experiments. There will be an additional computer workstation that has a logic programmer and printer installed and is connected to a projector. It will be used for laboratory demonstrations, student printing of designs, and burning chips. We anticipate that all ECE and CEN students, approximately 220 students per year will take the CEN-281 laboratory. Offering 9 sections (3 TAs) each semester would still allow for significant growth in the laboratory maintaining an efficient utilization of TA and faculty resources.

The laboratory would be equipped for 12 stations each having a development kit, oscilloscope, software, and PC. Additionally, the lab would be equipped with two logic analyzers, two logic programmers, one laser printer, a PC with software, and a projector. The total cost will be approximately $90,000. CEN-383 and 583 will initially share the same ten-workstation laboratory. Each workstation will have a signal generator, power supply, oscilloscope, 8052 development station, PC with software, and miscellaneous breadboards, connectors, and wires. The lab itself would also have three logic analyzers, two logic programmers, a projector, a PC with software, and a laser printer. The total cost is projected at $130,000.

5.1.5 Project Work Laboratories

Design and implementation of engineering projects is a critical component of the computer engineering educational process. Most undergraduates will gain this experience in CEN-499. Projects will consist of the design and construction of computer-based electronic projects. Students require secure space in which to congregate with their peers and mentors and to maintain project hardware and test equipment. The details of this will vary from instructor to instructor but will require extended periods of time working at a reasonably equipped development lab workbench. We envision space development lab with storage facilities to safely store student projects. Five student groups should be allowed to work on their projects concurrently. We believe equipment similar to that in the CEN-383 - 583 laboratories will serve the students well. More space, per station, than the 383-583 lab will be required as the development teams will be larger, their projects will be larger, and they will have to store their models to allow others to use share the lab space. This laboratory will be equipped in a manner similar to that for CEN-383 and 583 at a projected cost of $65,000.

5.1.6 Library

Library facilities appropriate to support a Research I graduate program in engineering and sciences is required. Adequate resources are available to start a computer-engineering program. In the future library acquisitions suggested by the Departments of Computer Science and Electrical and Computer Engineering will be made with consultation with faculty members participating in the Computer Engineering program.

5.1.7 Faculty

The faculty will formally be members of either the Electrical and Computer Engineering or Computer Science faculty. The department chairs will use the distribution of effort agreements to detail the degree of involvement by each faculty member to the program.

5.1.8 Space

Adequate space for the instructional laboratories, faculty research laboratories, teaching and research graduate assistants, and for new faculty offices is of paramount importance.

5.2 Expenditures for the Program

5.2.1 Recurring Personnel Costs

Approximately 12 fte faculty will need to be involved in offering the curriculum of the Computer Engineering program. We anticipate that approximately 3.5-4.5 fte faculty from both CS and ECE will be involved in teaching courses used in the CEN program. Clearly, CS, ECE and CEN students will jointly subscribe to many of the course offerings, especially in the freshman and sophomore years. Additional faculty and staff will need to be devoted to this program. The tables in Appendix II-F shown how teaching resources are allocated to the current ECE and CS programs for courses that will be affected by the establishment of a CEN undergraduate program. For this program alone we need an additional 10 course offerings per year by faculty, an additional four by instructors, and 9 fte TAs. We believe that we will need at least 4 additional courses offered at the graduate level to sustain a new program. This requires a total of 18 additional course offerings per year. Assuming an average of 3 courses per year for new and research-active faculty, we will need 4 courses from an instructor (4/8 = 1/2 an instructor) and 14 courses by faculty (14/3 = 4.67 faculty). We believe that if we had a full-time

instructor we could adjust the schedule so that we could maintain a viable computer-engineering curriculum with the following additional staff. The estimated recurring costs for four faculty members, an instructor, 12 teaching assistants, a technician, and an additional staff member will be approximately $700,000 per year.

5.2.2 Recurring Operating Costs

Equipment maintenance and upgrades, supplies, travel, and telephone are estimated at $135,00 per year.

5.2.3 Start-up Costs

Faculty startup costs will be required as consistent with packages offered to new faculty in ECE and CS.

6 Amount and Source of Resources

- We anticipate that laboratories can initially be funded by solicited donations from alumni and industry. Recurring funding will be required from the University.

Appendices

Appendix II-A	Undergraduate Program Objectives
Appendix II-B	Graduate Program Objectives
Appendix II-C	Undergraduate Program Outcomes and Assessments
Appendix II-D	Graduate Program Outcomes and Assessments
Appendix II-E	Enrollment Projections
Appendix II-F	Faculty
Appendix II-G	Course Proposals

Appendix II-A- Undergraduate Program Objectives

Goal 1. Attract highly talented and motivated students to the computer engineering profession.

Objective 1.1: Attract and retain undergraduate and graduate students who will be successful in our Computer Engineering program.

Goal 2. Develop relevant technical skills in our students.

Objective 2.1: Institute and maintain industrial partnerships to:

- improve the quality and relevance of design and implementation experiences;
- assist in reviewing the curriculum for relevance and quality;
- strengthen applied and theoretical research experiences.

Objective 2.2: Improve the abilities of our students to

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

Goal 3. Develop communication and teamwork skills in our students.

Objective 3.1: Increase Co-Op/Pre-professional internship participation

Objective 3.2: Augment multi-disciplinary and team experiences for Computer Engineering undergraduates.

Objective 3.2: Improve the abilities of our students to:

- function on multi-disciplinary teams;
- communicate effectively.

Goal 4. Raise awareness of professional and ethical responsibilities to society in our students.

Objective 4.1: Improve the abilities of our students to demonstrate

- an understanding of professional and ethical responsibility;
- an understanding of the impact of engineering solutions in a global and societal context;
- a knowledge of contemporary issues.

Goal 5. Instill a desire and ability for life long learning in our students.

Objective 5.1: Improve the abilities of our students to discuss the importance of life-long learning and describe reasonable ways to engage in life-long learning.

Objective 5.2: Increase the opportunities for students to participate in computer engineering research projects and activities.

Objective 5.3: Increase the number of students continuing in post-baccalaureate education.

Goal 6. Provide our students the access to rewarding career opportunities.

Objective 6.1: Attract more major employers to participate in Co-Op, career fairs, and on-campus recruiting.

Objective 6.2: Increase the number of graduates placed in major companies offering established career paths for computer engineering professionals.

Appendix II-B - Graduate Program Objectives

Goal 1. Attract highly talented and motivated students with a strong background in computer science and/or electrical engineering to the computer engineering profession.

Objective 1.1: Attract and retain students who will be successful graduate studies in the Computer Engineering program.

Goal 2. Develop relevant technical and research skills in our students.

Objective 2.1: Institute and maintain industrial partnerships to:

- improve the quality and relevance of design and implementation experiences;
- assist in reviewing the curriculum for relevance and quality;
- strengthen applied and theoretical research experiences.

Objective 2.2: Improve the abilities of our students to

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

Goal 3. Develop communication and teamwork skills in our students.

Objective 3.1: Improve the abilities of our students to

- function on multi-disciplinary teams;
- communicate effectively,
- conduct independent research.

Goal 4. Raise awareness of professional and ethical responsibilities to society in our students.

Objective 4.1: Improve the abilities of our students to demonstrate

- an understanding of professional and ethical responsibility;
- an understanding of the impact of engineering solutions in a global and societal context;
- a knowledge of contemporary issues.

Goal 5. Instill a desire and ability for life long learning in our students.

Objective 5.1: Improve the abilities of our students to discuss the importance of life-long learning and describe reasonable ways to engage in life-long learning.

Objective 5.2: Increase the opportunities for students to participate in computer engineering research projects and activities.

Objective 5.3: Increase the number of students pursuing a doctoral degree.

Goal 6. Provide our students the access to rewarding career opportunities.

Objective 6.1: Increase the number of graduates pursuing academic careers;

Objective 6.2: Increase the number of graduates placed in research-oriented university and industrial positions;

Objective 6.2: Increase the number of graduates placed in major companies offering established career paths for computer engineering professionals.

Appendix II-C - Undergraduate Program Outcomes and Assessments

During the genesis of the undergraduate Computer Engineering Program we will emphasize the following objectives and assessments of the programs.

Goal 1. Attract highly talented and motivated students to the computer engineering profession.

Objective 1.1: Attract and retain undergraduate and graduate students who will be successful in our Computer Engineering program.

Outcomes & Assessments:

We will collect academic information on the students electing to enter the CEN program. Measures will include SAT and ACT scores, high school GPA, and high school rank in class (when available). Comparisons will be made to those students electing both computer science and electrical engineering. Normal attrition measures will be collected.

Goal 2. Develop relevant technical skills in our students.

Objective 2.1: Institute and maintain industrial partnerships to:

- improve the quality and relevance of design and implementation experiences;
- assist in reviewing the curriculum for relevance and quality;
- strengthen applied and theoretical research experiences.

Outcomes & Assessments:

We will continue an ongoing review of the curriculum with a team of faculty and external industrial peers to perform a detailed review of individual courses. Particular emphasis will be placed on the applied and research experiences available within the curriculum.

Goal 5. Instill a desire and ability for life long learning in our students.

Objective 5.3: Increase the number of students continuing in post-baccalaureate education.

Outcomes & Assessments:

We will track the postgraduate careers of our graduates and will compare them quantitatively with their peers in other engineering disciplines.

Goal 6. Provide our students the access to rewarding career opportunities.

Objective 6.2: Increase the number of graduates placed in major companies offering established career paths for computer engineering professionals.

Outcomes & Assessments:

We will track the initial, and where possible, subsequent, employment of our graduates. A qualitative measure of the strength of their employment will be made with the assistance of industrial representatives.

Appendix II-D - Graduate Program Outcomes and Assessments

During the genesis of the graduate Computer Engineering Program we will emphasize the following objectives and assessments of the programs.

Goal 1. Attract highly talented and motivated students with a strong background in computer science and/or electrical engineering to the computer engineering profession.

Objective 1.1: Attract and retain students who will be successful graduate studies in the Computer Engineering program.

Outcomes & Assessments:

We will collect academic information on the students applying to enter the CEN graduate program. Measures will include GRE and undergraduate GPA. Comparisons will be made to those students admitted to both Computer Science and Electrical and Computer Engineering. Normal attrition measures will be collected.

Goal 3. Develop communication and teamwork skills in our students.

Objective 3.1: Improve the abilities of our students to

- function on multi-disciplinary teams;
- communicate effectively,
- conduct independent research.

Outcomes & Assessments:

We will collect information on all group projects, research seminars, papers submitted and accepted by out graduate students.

Goal 5. Instill a desire and ability for life long learning in our students.

Objective 5.3: Increase the number of students pursuing a doctoral degree.

Outcomes & Assessments:

We will collect information on all matriculating students to determine their prograss throughout their graduate program(s).

Goal 6. Provide our students the access to rewarding career opportunities.

Objective 6.1: Increase the number of graduates pursuing academic careers;

Objective 6.2: Increase the number of graduates placed in research-oriented university and industrial positions;

Objective 6.3: Increase the number of graduates placed in major companies offering established career paths for computer engineering professionals.

Outcomes & Assessments:

We will track the initial, and where possible, subsequent, employment of our graduates. A qualitative measure of the strength of their industrial employment will be made with the assistance of industrial representatives. The faculty will judge the strength of academic appointments.

Appendix II-E - Enrollment Projections

The table on the next page summarized the committee's estimation of the impact on enrollments by the establishment of the proposed program. We assume that there will be 20 students matriculating at UK because of the presence a computer-engineering program. Additionally, we assume that there will be 30 students who would have been Computer Science majors selecting the program as would 30 of the current entering electrical engineers freshmen.

The impact on the departments of the freshmen will be minimal. There will be some additional College enrollment that we estimate at 20 per year. The other potential Computer Engineering freshmen will reduce the number of CS and ECE freshmen majors. Recall that they will only be taking the professions course, CS-115, and 215. The impact of migration between CS, ECE, and CEN the first semester will be non-existent. All students need all the classes regardless of the eventual program they decide upon. In the second semester CS-215 can be an optional course for a student electing to eventually pursue ECE and is needed in the other programs.

In the sophomore year the number of students really becomes critical. CEN-280 is currently required for both CS and ECE majors, but the proposed CEN-281 will have to be offered in small sections to computer engineering students. Similarly CEN-216 is also offered mostly to CS students in small sections. We believe that the estimate of approximately 80 students being pre-computer engineering at this point of their career is a reasonable expectation. Although most of the attrition should take place in the freshman year we anticipate that an additional net 10-15 students will be lost from the program prior to attaining Engineering Standing.

Appendix II-F - Faculty

Below is a table of faculty currently offering sections of courses in the CEN area. This amounts to approximately 50 courses per year.

Faculty	CEN/yr
Baxter - CS	2
Calvert- CS	1
Dietz - ECE	4
Distler - ECE	6
Finkel- CS	1
Griffioen - CS	2
Hayes	2
Heath - ECE	4
Jaromczyk - CS	2
Lumpp - ECE	4
Mannavanin - CS	2
other	4
Instructor / TAs	16
	50

Below is a table that projects the number of additional sections that would need to be offered were the computer-engineering program implemented to the level anticipated. We project the need for an additional 12 TAs and 23 sections of classes. If we move some of the course load in CEN-280 and CEN-281 to instructors we will need approximately 16 new course-sections offered by faculty. The addition of four new faculty members with minor redistribution of teaching assignments of the existing faculty will meet the teaching requirements of the proposed program.

	Current -99-00			Projected			Increase		
	Fac	Inst	TA	Fac	Inst	TA	Fac	Inst	TA
CEN-100				1		.5	1		.5
CS-115		5	6		5	6			
CS-215		3	6		4	7		1	1
CEN/CS-216		6			8			2	
ECE-211	2		1	3		3	1		2
ECE-221	2		1	3		3	1		1
ECE-222	2		3	2		4			1
CS-275	2	2	3	3	3	4	1	1	1
CEN/ECE-280	5		2	6		3	1		1
CEN/ECE-281	2		3	2	2	6		2	3
CS-315	2		1	3		2	1		1
CEN/ECE-380	4		4	5		5	1		1
CEN-383				2	1	4	2	1	4
ECE-421	2			2		1			1
CEN/CS-441	1		1	2		2	1		
ECE-461	2		2	3		2	1		
CEN/CS-470	2		1	3		2	1		
CEN-480				3		2	3		2
CEN-499				2			2		
	28	16	34	44	23	56	**16**	**7**	**22**

Appendix II-G - Course Proposals

The following course proposals have, or are being prepared for submission:

Course	Proposal
CEN-100 - Computer Engineering Professions	new course
CEN-216 - Introduction to Software Engineering	change to CEN - possible minor changes to content
CEN-280 - Design of Logic Circuits	change to CEN plus a major redesign to accommodate the optional laboratory
CEN-281 - Logical Design Laboratory	major change - 400 to 200 level change
CEN-380 - Microcomputer Organization	change to CEN
CEN-383 - Introduction to Embedded Systems	new course
CEN-395 - Independent Work in Computer Engineering	new course
CEN-441G - Compilers for Algorithmic Languages	change to CEN plus possible change in emphasis to include additional code generation topics
CEN-470G - Operating Systems	change to CEN - needs review by CEN committee.
CEN-480G - Advanced Computer Architecture	"new" - major redesign - course was proposed by CS as CS-480G but has not been offered.
CEN-499 - Computer Engineering Design Project	new course
CEN-570 - Modern Operating Systems	change to CEN - needs review by CEN committee.
CEN-583 - Microprocessors	change to CEN - needs review by CEN committee.
CEN-670 - Distributed Operating Systems Theory	change to CEN - needs review by CEN committee.
CEN-685 - Digital Computer Structure	change to CEN - needs review by CEN committee.
CEN-686 - Advanced Computer Architecture Design	change to CEN - needs review by CEN committee.
CEN-748 - Master's Thesis Research	new course
CEN-749 - Dissertation Research	new course
CEN-768 - Residence Credit for Master's Degree	new course
CEN-769 - Residence Credit for Doctor's Degree	new course

Appendix III
Curriculum Vita for Faculty involved with Proposed Computer Engineering Degree Program

Curriculum Vita are in consecutive order following this cover page according to listings in the table below:

Faculty Member	Percent Effort to CpE Degree Program
William Dieter (ECE)	37.5% (3 sections/year)
Hank Dietz (ECE)	37.5% (3 sections/year)
Kevin D. Donohue (ECE)	25% (1 section + DUGS/year)
Joseph Elias (ECE)	12.5% (1 section/year)
Robert Heath (ECE)	37.5% (3 sections/year)
Lawrence D. Holloway (ECE)	12.5% (1 sections/year)
James Lumpp (ECE)	37.5% (3 sections/year)
Bruce Walcott (ECE)	12.5% (1 sections/year)
Mukesh Singhal (CS)	12.5% (1 sections/year)
Anthony Baxter (CS)	25% (2 sections/year)
Kenneth L. Calvert (CS)	12.5% (1 section/year)
Zongming Fei (CS)	12.5% (1 section/year)
Raphael A. Finkel (CS)	12.5% (1 section/year)
James N. Griffioen (CS)	12.5% (1 section/year)
Jerzy Jaromczyk (CS)	25% (2 sections/year)
D. Mannivannan (CS)	25% (2 sections/year)

SUMMARY OF ESTIMATED ENROLLMENTS & GRADUATION

BACHELOR'S PROGRAM

Table V. Anticipated enrollments in the CpE degree program

Year				
2004	2005	2006	2007	2008
110	146	194	258	344

Anticipated enrollments of New Students in the B.S.-CpE degree program=137

New Students are defined as those students who would have gone to a different university if Bachelor's in Computer Engineering degree program were not offered at UK.

Table VI. Anticipated graduates from the CpE degree program

Year				
2004	2005	2006	2007	2008
0	20	35	46	61

MASTER'S PROGRAM

Table V. Anticipated enrollments in the M.S.- CpE degree program

Year				
2004	2005	2006	2007	2008
25	34	47	57	65

Anticipated enrollments of New Students in the M.S.-CpE degree program=45

New Students are defined as those students who would have gone to a different university if Master's in Computer Engineering degree program were not offered at UK.

Table VI. Anticipated graduates from the M.S.-CpE degree program

Year				
2004	2005	2006	2007	2008
0	6	15	20	25

ADDENDUM TO PROPOSAL FOR INITIATION OF A NEW DEGREE PROGRAM

Bachelor of Science in Computer Engineering

Originally submitted by the College of Engineering September 2003

For submission to:

Commonwealth of Kentucky

COUNCIL ON HIGHER EDUCATION
1050 U.S. 127 South
Frankfort, Kentucky 40601

The following addendum is to accompany the computer engineering proposal recently considered by the undergraduate council. The addendum does not change curricular details or general administrative structure. It highlights:

1. How **resources** will be managed within the department of Computer Science and Electrical and Computer Engineering to launch the program.
2. Includes **applicable administrative details** that were listed in Appendix II of the proposal, and expands on the organization and resource allocation previous proposed in section 1.03 of the proposal.

1. **Resources.**

Below was a response originally in response the undergraduate council's questions on where resources would be found to launch the program from the ECE department. Added to this is an explanation of how the CS department will accommodate to support the program

Question #4 from The Undergraduate Council Subcommittee

The memo states that all of the resources will be supplied by the department, but when the math is done, this doesn't seem to add up. It appears that a deficit will occur. Can you find out if this is a fact, and if so, how this will be handled?
Thank you.

Response from the ECE Department

Originally, it was envisaged that the resources needed for the computer engineering degree programs will be derived from external funds. However, in light of developments over the last three years, which included the setting up of new laboratories and courses in the ECE department, it has now become possible to start the degree programs through internal reallocations. For example, the proposal called for 4 additional faculty lines in computer engineering. These will now be supplied by the 4 vacant faculty lines in the ECE department. Even though these vacancies occurred due to retirement and attrition in other areas of ECE like electrical power systems, priority area for the new hires will be computer engineering, thus resulting in a reconfiguration of the faculty strengths. In future, when resources for new faculty lines become available, other areas of electrical engineering will be replenished.

In addition, course offerings and teaching commitments have been reconfigured for higher efficiency and will be streamlined further to meet the demands of the computer engineering degree programs. The ECE department, at present, has 27 faculty lines (including 4 vacancies), 3 active adjunct and joint faculty members, one Instructor position and 16 Teaching Assistant (TA) positions. Of these, more than ten faculty members can teach computer engineering courses. We will re-configure the teaching commitments so that the computer engineering courses (with additional sections because of expected additional enrollments) can be taught. With the objective of increasing the effectiveness of our teaching faculty and TAs with minimal reduction in service to our students,

1. We have begun to offer many elective laboratories like EE 416 and EE 481 only once every two semesters. This trend will continue.
2. Number of sections of design projects in EE499 has been reduced .substantially.
3. Most, if not all, 500 level courses are being offered only once every two semesters.
4. We plan to keep the labs open for more than 12 hours a day and teach more sections with minimal additional resources.

As a result of curriculum streamlining and improved teaching efficiency measures listed above, we expect to be able to run the computer engineering degree program for the first year with little or no additional resources.

As the enrollments increase (as expected) after one year, we may well need to open more sections. This would require two additional faculty members. Based on our present 4 vacancies and one imminent (expected) retirement, we are optimistic that we will be able to add 2-4 faculty in the computer engineering area. At that time, we will also request additional TAs from the administration.

Some other costs will be handled as follows,

Supplies: For the first year, supplies will be covered by salary savings and grant proposals.
Travel: Cancelled until new resources appear.
Equipment: A major portion of the absolutely essential instructional equipment is already in place; it was acquired through grant proposals and CPE funds over the last two years. We plan to write grant proposals to federal agencies, companies and alumni to get more equipment in the future.

Response from the CS Department

The Department of Computer Science estimates that the demand on departmental resources posed by a student in the Computer Engineering program will be about 50% of the demand posed by a CS major.

We estimate that in the first two years when the Computer Engineering BS program is offered, the enrollment in the program will be of the order of 60-80 students, 20 of whom will be transfer students from the CS program. In the same period we estimate CS enrollments at the level of
480 students. Thus, the combined enrollment will be at the level of 480 CS majors + 0.5 x 80 Comp Eng majors for the total of 520 students.

Current departmental resources, while stretched to the limit, are adequate to handle such levels of enrollments and we do not foresee problems during the first two years of the program. If the total enrollment, computed according to the formula given above, exceeds 540 - the CS Department will need to obtain additional resources from the College or revise program admission criteria.

2. Administrative Organization

Section 1.03 of the submitted proposal reads:

> **Relationship to University Organizational Structure:**
> **Describe the organizational placement of the program within the institution's organizational structure.**
>
> The computer engineering degree program will reside in the Department of Electrical and Computer Engineering (ECE) and will be administered by the ECE Chair. However, the faculty from the Department of Computer Science (CS) will share equally in resources, responsibilities, teaching of courses, and advising of students.
>
> Relationship to University Organizational Structure:
>
> -University of Kentucky
> -College of Engineering

-Department of Electrical and Computer Engineering
-Computer Engineering Degree Program

The addendum clarifies the language and adds detailed points from Appendix II:

The computer engineering degree program will reside in the Department of Electrical and Computer Engineering (ECE) and will be administered by the ECE Chair. However, the Department of Computer Science (CS) will share equally in resources, responsibilities, teaching of courses, and advising of students.

Relationship to University Organizational Structure:

-University of Kentucky
-College of Engineering
-Department of Electrical and Computer Engineering
-Computer Engineering Degree Program

Administrative Structure

Major features of the administrative structure of this program are as follows:

1. The teaching and research faculty of the Computer Engineering Program will be drawn from the Electrical and Computer Engineering (ECE) Department and the Computer Science (CS) Department in the College of Engineering at UK.
2. The ECE chair will be responsible for the day-to-day operation of the program. However important decisions about the program require consultation with the CS chair. The CS chair will make the determination of which issues and decisions are to be categorized as "important."
3. All resources, revenues and expenses (including those related to student credit hours) relating to the Computer Engineering Program will be shared proportionally between the ECE and the CS Departments.
4. To illustrate the equality of the ECE and CS Departments in the execution of the program, the CS department chair and the ECE department chair will share the handing out of the Computer Engineering degrees at the commencement ceremonies.
5. The ECE department will apply for, and secure ABET accreditation for the Computer Engineering Degree.