

**ABSTRACT:**

Students of technology related fields are required to study several courses in mathematics. A good grasp of higher mathematical concepts such as calculus open the door to solving the complex analysis and design problems these students face. However, all too often, technology majors are forced to enroll in calculus courses that concentrate on using examples following business and insurance models to reinforce the presented content. These exercises are great reinforcement for those pursuing business and insurance careers. But, technology majors have a hard time transferring the presented concepts and exercises to their particular discipline.

The purpose of this project is to develop Web delivered modules that present key calculus concepts designed specifically for technology majors as well as for workers in the technology workforce. An individual enrolling in ECT 421, Circuit Analysis by Calculus, a three credit hour course and successfully completing each module will satisfy the requirements for the course. ECT 421 is a required course for DegreeLink students pursuing a Bachelor of Science degree in Electronics Technology from Indiana State University. Each module will be designed as a “stand-alone module”.

Since its inception in 1998 DegreeLink has accepted many Indiana residents into the Electronics Technology program. For the most part DegreeLink students are non-traditional students who are place-bound. ECT 421 is the only course within the Electronics Technology program that has not been designed for distance delivery. As such, 100+ students desiring to complete their degree are waiting for this course.

The benefit of developing these modules goes beyond ISU. Other Indiana institutions offering technology related courses will be encouraged to use any modules they feel will enhance their courses. These interactive rich modules will also be shared with MERLOT and other “free source” Web content repositories. Additionally, professionals in the industrial workforce could, through ISU’s Continuing Education program, access the modules which would allow them to hone their skills.

It is proposed that three major modules be developed and they would each be composed of sub-modules for a total of fifteen instructional modules. The average student should expect to spend approximately 6-8 hours interacting with the content or participating in the learning activities of each module. If followed in a linear fashion it is expected that the student will be able to complete the full course within fifteen weeks.

The proposed project requests a total of \$35,608.00 funding with a \$19,500.00 matching contribution by Indiana State University. It requests an amount of \$16,108.00 from the Course and Module Development Grants program of the Indiana Partnership for Statewide Education (IPSE).

## **I. Market Analysis (Need, Audience, Demand and Marketability)**

### The Need

DegreeLink, is a partnership of Indiana State University, Vincennes University and Ivy Tech State College created to develop seamless program articulations. The main intention of DegreeLink is to provide access to a baccalaureate degree for Hoosiers who are time-bound, geographically-bound and financially challenged. These students receive courses through a variety of distance education technologies.

Since DegreeLink's inception in 1998 the writer of this grant has consistently taught IHETS and two-way video courses for ISU's Electronics and Computer Technology department. During this time he has seen consistent growth in the student enrollments. To date over 100 students have been admitted into the program and taken his courses.

So far all of the major courses have been developed for delivery except ECT 421, Circuit Analysis by Calculus, a three credit hour course. ECT 421 is a capstone course to be taken during the last semester of a student's program. Students taking ECT 421 are required to have taken a survey of calculus course prior to enrolling in the course. However, the survey courses do not present the material in a manner that is relevant to the electronics students and most students come into ECT 421 with minimal mastery of calculus concepts. They desperately need a course specifically tailored to their interests.

A person might ask, "Why should resources be expended on this endeavor?" The following statistics are from the Occupational Outlook Handbook of the US Department of Labor's Bureau of Labor website (<http://www.bls.gov/oco/ocos031.htm>):

- Electrical and electronics engineers held about 288,000 jobs in 2000, making their occupation the largest branch of engineering.
- Job opportunities in the electronics/electrical engineering fields should increase about 20% between the years 2000 and 2010.

A recent search of the Indiana College Network's website (<http://www.icn.org>) for any Indiana institutions offering similar content turned up zero possibilities. A Web search of Indiana institutions offering technology and engineering courses similar to this proposal also came back negative. At this time no offerings of the proposed course content is being made within the Indiana higher educational system.

### Target Audience

The primary learners to be served with the product of this project are individuals who elect to enroll in the DegreeLink ECT program. The majority of DegreeLink students are non-traditional students. They are usually more mature students who are working in "blue collar" electronics technician positions and support families. Many attained their associates degree in electronics years ago and pursued a path where they were able to apply their knowledge. However, after several years on the job they find they need more education to further their career paths. They know that attaining higher education will allow them to be more marketable and open doors to higher paying positions. According to the OOC website, nationally the median annual earnings in year 2000 of electrical and electronics engineering technicians was \$40,020 in 2000 versus electrical engineers having a median annual earnings of \$64,910.

DegreeLink affords these tax paying Hoosiers the opportunity to pursue further education without forcing them to quit their employment or demand that they move to the locale of a university. Without this program these Indiana residents would not be able to complete their educational goals.

A secondary, but just as important, audience consists of technology and engineering instructors teaching courses covering similar content as ECT 421. Other Indiana universities offer technology or engineering technology courses. Each instructor grapples with the problem of how to get his/her student to make the connection of how calculus can be applied to electronics problems. The modules produced by this project will serve as another powerful learning resource.

A third distinct audience also exist. Individuals currently holding electrical engineering positions know they need to keep their analysis skills honed. According to the OOC website: “Continuing education is important for electrical and electronics engineers. Engineers who fail to keep up with the rapid changes in technology risk becoming more susceptible to layoffs or, at a minimum, more likely to be passed over for advancement.” These discreet modules would allow electronics and electrical engineers to sharpen only the skills they need to sharpen without having to take complete courses.

### Demand

As mentioned in “The Need” above, over 100 students have been enrolled in the distance delivered Electronics Technology program. Since all of the current students need this course it stands to reason there would be a large initial influx of students. As the current DegreeLink students graduate from the program and obtain higher paying positions their technician peers, having noted the success, will be inspired to enroll into the DegreeLink Electronics program and further their own education. It is a conservative estimate that latter semesters would see a minimum of twenty students per semester benefiting from a distance delivered offering of this course.

### Marketability

Greater detail will be shared in the section “Marketing Plan”. The following is a brief synopsis of planned dissemination of the module/course availability:

- DegreeLink already advertises courses available within it’s various programs. Students currently enrolled in the Electronics Technology program, as well as individuals interested in the program, will be made aware of the course offering.
- The course will be made available through the Indiana College Network.
- Instructors teaching technology/engineering courses at the various Indiana universities will be contacted via email and print materials informing them of the availability of the modules.
- Professional organizations such as: the Institute of Electrical and Electronics Engineers, the Accreditation Board for Engineering and Technology and the National Institute for Certification in Engineering Technologies will be contacted and made aware of the modular instructional units and how their members can gain access.

## **II. Instructional Design and Delivery Plan**

ECT 421 will be delivered on the Web and structured in a modular format. Three major modules will be delivered. The three modules are:

Module 1: AC series circuits solved using calculus concepts

Module 2: AC parallel circuits solved using calculus concepts

Module 3: AC series-parallel circuits solved using calculus concepts

Each module will follow the same format as outlined below:

1. Pre-test. The learner will be presented with a pre-test to gauge his/her entry level knowledge. This pre-test will be online and consist of several analysis problems similar to the end of the unit post-test questions. Upon completion of the pre-test the learner will receive immediate feedback as to the level of prior knowledge he/she possesses. Feedback will also be given as to where the student has displayed deficiencies, or gaps, in their basic knowledge and a step-by-step analysis of how to arrive at the correct answer will be given. The pre-test serves to inform the learner as to his/her knowledge gaps, indicating where (s)he needs to pay particular attention as (s)he progresses through the module. This will, in effect allow the student to “tailor” his/her instructional strategy as (s)he works through the module’s content.
  
2. Presentation of the instruction. The instruction will be presented in the following manner:
  - a. A brief overview of the objectives is given. This serves to inform the student as to what they should expect to learn.
  - b. An example circuit is displayed and the problem to be solved presented. Flash (a computer program capable of animating web graphics) will be used to simulate actions within the circuit, e.g. switches opening/closing, current flow, etc.
  - c. A detailed step-by-step procedure for solving the problem will be given. A link will accompany each step. If the student has confusion over the particular step (s)he can click on the link for further clarification on the concept.
  - d. Another problem similar to the above example will be presented. The student will be asked to respond by inputting an answer. Correct submission will elicit positive feedback and the student should progress to the next question. An incorrect answer will prompt the student to click on a link that will reveal a step-by-step procedure for properly solving the problem.
  - e. The student will next work through several more problems, each problem being progressively more difficult to solve. The student will receive feedback as to his/her answers as in the above step. This progressive removal of supports helps the student to learn to synthesize and apply the knowledge learned in the content presentation.
  
3. Post-test assessment. A post test will be given to assess the level of knowledge attainment the student has reached. Upon completion of the post-test the student will receive immediate feedback as to how well (s)he performed on the assessment. The assessment score will be automatically entered into the online gradebook.

BlackBoard’s CourseInfo online course management system will be used to develop and deliver the course. Features of CourseInfo to be used are: Chat, discussion boards, announcements,

email, an online gradebook, assessment manager and document repository. Everything except the textbook will reside on the site.

The students will be expected to not only interact with the modules, but also with each other and the instructor. The instructor will post “virtual office hours” whereby the student can log into the course site and via Chat ask questions/receive guidance about the content. This will serve as a method of assuring the instructor the students are staying on task and give indications of problems so adjustments can be made if necessary.

A discussion board will also be maintained on the site and students will be required to respond to the weekly posted discussion question/topic. They will also be required to respond to their peers’ responses. This will force peer-to-peer interactions and help the students overcome potential feelings of isolation. Utilizing the Chat and discussion boards will help reinforce student learning and retention of the concept and serve as a “community building” catalyst.

### **III. Institutional Capacity and Commitment**

Indiana State University provides its full cooperation and supports the development of programs and courses for distance education. ISU is aware that successful completion of this proposal will enable the last course in the ECT program to be developed. Upon delivery of this course it is agreed that it will be offered on a scheduled rotational basis. Institutional infrastructure already supports the delivery of Web-based courses. Additionally, the Center for Teaching and Learning (CTL), Media Resources Center and Faculty Computing Resources Center are committed to assist this project with their resources such as: instructional design assistance and graphics and computing specialists.

### **IV. Utilization Potential**

In order to reach maximum utilization the content is designed in a stand-alone modular format. As such not only will it serve the needs of a required course, but also for other institutions. The modules will be made available as “open resources” to all Indiana institutions. The content will be useful for technology, physics and math instructors.

The project director serves as a member of the MERLOT Faculty Development board and realizes the importance of good instructional content. Modules will be submitted to MERLOT (<http://www.merlot.org>) a repository of online resources, for free usage by instructors worldwide.

### **V. Marketing Plan**

ISU has made a major investment in the DegreeLink program. Enrollments in the DegreeLink programs are evidence of the effectiveness of their marketing campaigns. This course will be actively marketed as a key course for completion of the Electronics Technology program of studies. Existing students in the ET program will be encouraged to enroll in the course. The course will be highlighted within promotional materials to prospective students. The course will also be offered through the Indiana College Network (ICN) as a for credit course.

Instructors at other Indiana institutions will be informed of the availability of the modules via email. Targeted emails will go to each Electronics, Engineering, Physics and Technology program. Any instructor responding with an interest will be given open access to the content.

### **VI. Evaluation Plan**

Formative evaluation will consist of expert review and beta testing. As each module develops fellow faculty members of the ECT department will review the materials. This will ensure the quality and quantity of the content. These expert evaluations will point out any deficiencies or confusion points and their suggestions will be incorporated.

Before the course is publicly offered, a beta group of students will take the course and their feedback will be solicited. Feedback will come from this beta group in the form of anonymous surveys, emails and interviews. Quantitative and qualitative data will be gathered on the effectiveness of the instruction, site usability, interactions with peers and instructor and overall student satisfaction.

During the delivery of the course student feedback will be gathered via the weekly “virtual office hours”, email and the discussion board postings.

Formal assessments in the form of post test will evaluate the effectiveness of the content presentations. Periodic anonymous surveys will solicit student feedback on the effectiveness of the instruction and the students’ level of satisfaction. A summative anonymous survey will be given at the end of each module to gauge the effectiveness of the module and the students’ satisfaction level.

It is believed other faculty members will benefit from feedback received from the students. The feedback may prove valuable to them as they develop courses for future delivery. The project director will share data gathered with other ISU faculty. Additionally, the project director is open to presenting his findings before an inter-institutional body such as the IPSE All Partners Conference.

## **VII. Project Schedule**

The following timeline will be followed:

2003	Spring	design of modules
	Summer	develop modules #1, #2 and #3
	Fall	peer reviews and revisions of the modules
2004	Spring	course offered to beta group of students, revise as necessary
	Summer	course offered to distance students, revise as needed

## **VIII. Key Development Personnel**

**Mr. Donald Kaufman** will serve as the project director. He has taught distance delivered Electronics Technology courses at ISU since 1995 and is actively working on his dissertation to finish his doctorate in Instructional Systems Technology. He will coordinate the activities of the instructional designer, graphics and development personnel. The project director is a graduate of the Course Transformation Academy offered by the CTL and has utilized Blackboard’s CourseInfo for several years as a supplement for distance delivered courses.

**Dr. William Croft**, Chair ECT department, has agreed to review the modules and give expert peer feedback. Dr. Croft has a doctorate in Mathematics Education.

**Mr. M.C. Greenfield**, ECT instructor, has agreed to review the modules and give expert peer feedback. Mr. Greenfield teaches ECT 421 as a face-to-face course at ISU.

## **Budget Narrative**

The total budget for this project is \$35,608.00. Grant funds in the amount of \$16,108.00 are requested in this grant to cover the expenses listed below. Indiana State University is committing \$19,500.00 of in-kind support to this project. The rationale for salaries is as follows: It takes an average of twelve hours of overall design and development work to transform one hour of student learning in a traditional course to an online environment. Some consider this a very conservative estimate. "The figure of an average of 18 hours for Web development seems to be just about right with this supporting data. Perhaps we could be even more accurate by providing a range of 5-23 hours." (Judith V. Boettcher, How much does it cost to develop a distance-learning course? Syllabus May 1998). As there are forty-five learning hours (3 credits X 15 weeks) in a normal semester, it stands to reason that  $45 \times 15 = 540$  hours to design and develop a course for Internet delivery.

### **IPSE requested funds: (\$16,108.00)**

#### Salaries and fringe benefits (\$15,631.00)

The Project Director is confident he can produce this course in an online modular format with an investment of 300 hours of his time. This effort will be independent of all other work responsibilities. A fair compensation has been figured at \$13,398.00 including fringe benefits (salary \$12,000.00 + fringe benefits \$1,398.00).

Dr. Croft and Mr. Greenfield will serve as expert reviewers. An amount of \$1,116.50 (salary \$1,000.00 + fringe benefits \$116.50) is budgeted for each reviewer for a total of \$2,233.00.

#### Software (\$477.00)

Macromedia MX Studio is a Web enhancement software tool. An upgrade to MX Studio is budgeted at \$477.00.

### **ISU matching funds: (\$19,500.00)**

Instructional Design assistance up to 150 hours ( $\$50.00 / \text{hour} = \$7,500.00$ ) has been agreed upon.

Graphics Designer support of up to 150 hours ( $\$40.00 / \text{hour} = \$6,000.00$ ) has been agreed upon.

Instructional development support from the Faculty Computing Resource Center in the amount of 200 hours has been committed ( $\$30.00 / \text{hour} = \$6,000.00$ )

## **Appendix A**

### Project Director's Qualifications

Donald Kaufman received his B.S. and M.S. degrees in Electronics and Computer Technology from Indiana State University. Since 1995 he has been teaching distance delivered courses for the ECT department. He was the first instructor within the department to teach a DegreeLink distance delivered course and each semester teaches two three credit hour courses using technology. The courses he is teaching are currently offered via two-way video with using the Internet (CourseInfo) as a supplement.

From 1998 to 2000 the Project Director was the senior Instructional Designer at Indiana State University. His primary responsibility was to assist faculty in transforming their courses for distance delivery including via the Web. He was instrumental in convincing ISU to adopt BlackBoard's CourseInfo and has thousands of hours of experience with this course management system. Another part of his responsibility was to improve the teaching process at ISU. He was a central player in designing and delivering the Course Transformation Academy, a structured series of faculty workshops designed to expose faculty to best practices in pedagogy, instructional design and the use of technology in improving the teaching process.

Since 2000 Kaufman has been the Director of the Center for Teaching and Learning at Vincennes University. In this capacity he works closely with faculty desiring to improve their teaching. He has designed and delivers a series of workshops, the Teaching Transformation Academy, and has had over 60 VU faculty graduate from it. Additionally, Kaufman is the campus administrator of the BlackBoard system at VU. In this capacity he works closely with many instructors desiring to use BlackBoard for online instruction.

Kaufman has been accepted as a doctoral candidate within the doctoral program of Instructional Systems Technology at Indiana University-Bloomington. He is currently in the research stage of his dissertation.