Chapter XXXIV

Information Systems Curriculum Design Processes

Paulette Alexander
University of North Alabama, USA

Carol Gossett
University of North Alabama, USA

ABSTRACT

The process of designing a university curriculum in the information systems discipline needs to follow many of the same processes that professional systems analysts use. Of concern are the product, the stakeholders, the drivers, and the methods; indeed, an information systems curriculum is an information system. This chapter presents a case study of one small regional university’s efforts to create an updated information systems curriculum addressing the challenges of curriculum development using the framework of the very systems analysis and design course content that the students are expected to learn. The chapter identifies each component of the information system curriculum and details the processes supporting each development step along the way, from problem identification to system operation and support. This case study presents a cohesive approach to dealing with the many pressures associated with information systems curriculum development and might be instructive for curriculum development in other disciplines as well.

INTRODUCTION

The University of North Alabama has offered undergraduate courses leading to a baccalaureate degree in information systems fields since 1978. The programs were first called management information systems, then computer information systems (CIS). During the first couple of decades, these programs were part of the Department of Management and Marketing within the College of Business. In the mid-1990s a separate Department of Computer Information Systems was formed within the College of Business, incorporating the CIS programs and courses and those associated with the former Administrative Systems Management Department. During the first two decades of information systems programs, the curriculum was revised and updated numerous times, sometimes by adding courses and sometimes by totally recasting the degree requirements of the program. Attention was given to the latest technologies and to issues involving the application of technologies. Curriculum guidelines
from the Association for Computing Machinery (ACM, 2005) were consulted, and faculty attended conferences and workshops dealing with curriculum matters. Faculty also maintained contact with many alumni and local employers in an effort to maintain a program which would properly train students to take their place in the ever-changing world of technology.

Since 2000, the enrollment of CIS majors has hovered somewhat above 200, fluctuating slightly from year to year, but not experiencing the precipitous drop reported by many universities. The number of full time faculty grew from 8 in 2000 to 10 at present and from two doctorally-qualified members to six. In addition to teaching courses in the CIS undergraduate major, CIS faculty members teach a basic computer applications service course required by most majors in the university, enrolling approximately 1,500 students per year. The graduate information systems program, part of the Master of Business Administration, new in 2004, now has over 50 students enrolled. The CIS department is also the subject-area home to the program responsible for preparing high school teachers of business and marketing education at both the bachelor and master of education level.

In the fall of 2004, it became clear to the faculty of the CIS department at the University of North Alabama (UNA) that a problem existed with its current curriculum. The courses being taught were not meeting the needs of the students as they prepared to enter the job market. The department’s faculty needed to solve the problem by designing a curriculum to meet the needs of a CIS graduate entering the work force. How would they solve this problem? As information systems people, the faculty decided to use a problem-solving technique familiar to all the faculty members: the principles found in systems analysis and design.

When a university faculty undertakes a major curriculum revision, there are many issues to address and many procedural hurdles to cross. These are in many ways similar to the various types of constraints generally faced by information systems developers and systems analysts. All too often, it is difficult to admit to deficiencies in an existing system (curriculum) because there are stakeholders with interests in preserving the status quo, pressures that are resistant to change, decision makers who are not fully informed of all relevant facts, outside evaluators who have established standards which must be upheld, and the list goes on. But in short, the curriculum development process requires the buy-in of a wide variety of stakeholders, including faculty, university administration, curriculum committees, alumni, potential employers of graduates, and, of course, students. The extent to which each stakeholder group accepts and embraces a curriculum is an important element of how successful the overall project is and in the case of curriculum development, how successful the program will become.

Maintaining a program with high standards, such as those required by accrediting agencies, was important to the faculty. “Accreditation focuses on the quality of education...A high quality degree program is created when students interact with a cadre of faculty in a systematic program supported by an institution” (SACS, 2007). The university holds the regional accreditation. The College of Business holds accreditation by the Association of Collegiate Business Schools and Programs (ACBSP, 2007). The college and department faculty and administration are committed to seeking additional accreditations as appropriate.

Inasmuch as the ultimate objective of curriculum revision is educating students to achieve their objectives, usually employment objectives, the product can be assessed in terms of the types of employment objectives being targeted and the knowledge base and skills sets required to achieve those objectives. Accrediting organizations have, in recent years, come to emphasize learning outcomes as a primary element for educational institution and program evaluations. The notion of measurement of learning outcomes is also fundamental to concepts of continuous improvement and quality enhancement.

Historically, curriculum revisions have been course and credit hour-centric. In some profes-
sional programs which require licensure before a student goes into professional practice, there has been some coordination of the content within course sets constituting a program of study or a major. In most other curricula, there has been wide latitude to use teaching methods and to include content based on the individual professor’s preferences within a course. Indeed, this is one of the tenets of academic freedom. Because there could be a conflict between concepts of academic freedom and the prescriptive nature of courses with prescribed learning outcomes and assessment standards, it is especially incumbent upon programs developing curricula which seek to accommodate these competing priorities to seek full, fair, and open participation by all faculty who will in effect be subscribing to a “system” of courses to meet a prescribed and agreed upon set of learning outcomes.

This case study documents in considerable detail the process of a rigorous, comprehensive, time consuming, and apparently successful curriculum revision meant to address the multitude of pressures concerning what constitutes a quality information systems program, what types of employment opportunities the graduates would or should be prepared for, how to fit the needed course material together, and how to fit that material into existing degree structures within a college of business and a university, with constraints and expectations completely outside the control of the CIS faculty. In addition, many external pressures and issues must be addressed in completing such a curriculum revision. Demonstrated in this case study are many of the concepts associated with competing priorities, allocation of scarce resources, establishing requirements, iterative decision making, user involvement, a desire to short cut important parts of the development process, and issues of implementation and transition. This case study’s objective is to present an application of concepts which are at the heart of information systems education and apply those concepts to the betterment of information systems education.

The systems development life cycle (SDLC) is used to plan and manage the systems development process. The SDLC model is considered a waterfall model as the result of each phase flows sequentially into the next phase. A typical SDLC model will include the following steps or phases:

- Systems Planning
- Systems Analysis
- Systems Design
- Systems Implementation
- Systems Operation and Support

When the time arrived for the faculty to revamp the curriculum to meet the needs of the current job market, the same concepts found in the SDLC model were the obvious methods to reach the goal efficiently.

**SYSTEMS PLANNING**

In an SDLC model, the purpose of the initial step is to complete a preliminary investigation to identify the nature and scope of the problem. In this step, the analysts evaluate the problem and initiate the process of discovering the details, sometimes referred to as fact-finding. Whitten and Bentley (2007) state that “the problem analysis phase provides the analyst with a more thorough understanding of the problems, opportunities, and/or directives that triggered the project” (p. 174).

Students pursuing a CIS major had 3 alternatives: Option I: Application Programming and Design; Option II: Micro Systems Design; or Option III: Business Technology Management. The first option provided the student with a strong background in a mainframe programming environment using COBOL. The second option supplied the student with a diverse background in programming in a Microsoft Windows environment using C++, Java, and Oracle. The third option offered the student an opportunity to enter the information technology (IT) arena for a career but yet avoid the programming and technical
aspects of the other major options. This option allowed the student to focus on Web design, desktop publishing, and multimedia reporting.

Upon entering the systems planning phase, a strengths, weaknesses, opportunities, threats (SWOT) analysis was undertaken identifying the strengths, weaknesses, opportunities, and threats of the CIS program. The SWOT analysis focused on the areas of faculty, technology infrastructure, students, and curriculum.

The faculty’s strengths were in being dynamic, dedicated, competent, and multicultural professors. However, their weaknesses included teaching too many overload classes and preparing for multiple classes.

The state-of-the-art classroom hardware and software were found to be strengths for the technology infrastructure while a lack of technical support and a lack of an examination laboratory were listed as weaknesses.

The students’ participation in department-sponsored clubs and organizations and their high success in national and state business school competitions were definite strengths. The students were found to be lacking in mathematical logic skills and verbal skills.

Strengths of the curriculum centered on a finding that the current curriculum built strong collaborative skills as well as communication and presentation skills. The curriculum was reviewed frequently and Option II was perceived to meet the core competencies for Accreditation Board for Engineering and Technology (ABET) accreditation. The curriculum being Microsoft-centric and lacking real world projects were listed as weaknesses as was the fact that the curriculum did not meet the core competencies for ABET accreditation in the Option III area. *Criteria for Accrediting Computing Programs* (ABET, 2007) lists the curriculum standards for information systems programs as:

- All students must take a broad-based core of fundamental information systems material consisting of at least 12 semester hours.
- The core materials must provide basic coverage of the hardware and software, a modern programming language, data management, networking and communications, analysis and design, and role of IS in organizations.
- Theoretical foundations, analysis, and design must be stressed throughout the program.
- Students must be exposed to a variety of information and computing systems and must become proficient in one modern programming language.
- All students must take at least 12 semester hours of advanced course work in information systems that provides breadth and builds on the IS core to provide depth. (p. 9)

Many threats were identified. First, the department was too focused on Microsoft products to the exclusion of other vendors’ software. The Option III degree was perceived to be more of an office administration degree and less of a CIS degree. There was a keen awareness of the potential for loss of faculty to better paying jobs in industry and the need to continuously upgrade skills and proficiencies due to the rapid change in technology.

Several opportunities and challenges were identified for the department. Saying the words “opportunities and challenges” in the same sentence invokes visions of changes in the future. The ultimate goal of these changes was to better the program and therefore the student. “The philosophy of technology helps us understand how IT can be designed to enhance and/or transform social actors’ experiences of their organizational life-world and to improve the ways in which they interpret or relate to such technologies” (Butler & Murphy, 2007, p. 197, referencing a 1979 work of Don Ihde). The faculty felt a Web-based development option should be added to the curriculum to meet the needs of the job market. The CIS Club and Programming Club were being utilized in projects around campus and town and could be employed more with the proper dissemination of information. Recruiting seminars at local community colleges
and high schools have always been a strong point for this department. Continuing this policy should allow the department to build a strong relationship with potential freshmen or transfer students.

The SWOT analysis was an educational tool for the members of the CIS faculty. After verbalizing and visualizing the strengths, weaknesses, opportunities, and threats of the CIS program, the information collected in this phase was prepared and summarized for use in the next step of building a new curriculum to meet the needs of students entering the current job market.

**SYSTEMS ANALYSIS**

The purpose of this step in the traditional SDLC is to build a logical model of the new system. In this step, the requirements of the new system are investigated, agreed upon, and documented. The analysts use various team-based methods to visualize and document the new system. The discovery of details (fact-finding) continues in this phase as the analysts begin to research the requirements for the new system by using tools such as documentation review, sampling, and research.

The first step in the systems analysis phase of the curriculum revisions project was to describe the problems found in the current curriculum and to outline desired changes for the new curriculum. Baltzan and Phillips (2008) state that “systems are successful only when they solve the right problem or take advantage of the right opportunity” (p. 350).

The investigation began with a hard look at the current curriculum. Which classes are requested most by the students? Which classes are in the curriculum but are not being taught on a regular basis?

As evaluations began, the faculty was aware of the lack of interest in the Option 1 major. In fact, the COBOL programming classes were not even being taught. The strongest interests of the students lay in the Option II and Option III choices.

In another exercise, the faculty examined five case projects typical for senior level information systems students. An evaluation was completed to see what percentage of Option II students and Option III students should be able to perform these tasks as opposed to what percentage of students could actually complete the projects.

Considering this information coupled with the results of the SWOT analysis, the faculty went through an exercise utilizing joint application development (JAD) techniques to determine the path of the new curriculum. According to Shelly, Cashman, and Rosenblatt (2008), “a JAD team usually meets over a period of days or weeks in a special conference room or at an off-site location” (p. 96). Meeting in classrooms, conference rooms, and the local country club, JAD participants (faculty members) formed focus groups and participated in exercises to clearly define the new curriculum. In the first step of this exercise, faculty members wrote the job titles held by CIS alumni on yellow sticky notes. The next step was to write the names of careers desired by current students nearing graduation on yellow sticky notes. Next, the faculty identified which courses in the current curriculum supported the skills needed to do the jobs found on the sticky notes. In the final step, the faculty suggested additional courses that would be needed to properly prepare the students for these careers. This exercise allowed the faculty to see which career areas were absent from our teaching and where opportunities for supplementary courses existed.

Armed with the information of courses that were not being utilized, courses that were not quite fulfilling a need, and additional courses that were needed, the faculty progressed to the next phase of the development of the new curriculum, the design phase.

**SYSTEMS DESIGN**

The purpose of this phase of the SDLC is to develop a plan that will satisfy all the requirements for the new system that were discovered during the analysis phase. In this step, a physical model of the system
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is built to determine how the requirements will be met. Attempting to satisfy all the requirements was a lofty goal. The faculty understood this could be a process of many iterations. According to Alexander and Stevens (2002),

Getting started with anything is proverbially harder than doing it. It is perfectly acceptable to make some mistakes when you first try to organize any set of requirements. As long as you know that it is only a rough cut of the final structure, you can ask users to help you improve it. (62)

After discovering the requirements needed for the new curriculum, it was clear to the faculty members that two paths should be considered: end user computing systems (EUCS) and enterprise information systems (EIS). The EUCS option was designed for students who were interested in working in a support role for end users of smaller organizations which have less complex information systems demands, use more commercial software, and have more one-of-a-kind requests. The EIS option was intended for students who were interested in positions in a larger organization. These positions will most likely be dealing with larger, more complex projects to support the enterprise. The student would be part of a team composed of representatives from various departments within the company creating solutions for the organization. The student’s ability to create appropriate solutions will involve applying the knowledge gained from the CIS curriculum as well as knowledge gleaned from core business courses taken in route to a Bachelor of Business Administration degree. According to the Association to Advance Collegiate Schools of Business (AACSB International, 2007)

Undergraduate degree programs in business educate students in a broad range of knowledge and skills as a basis for careers in business. Learning expectations build on the students’ pre-collegiate educations to prepare students to enter and sustain careers in the business world and to contribute positively in the larger society. Students achieve knowledge and skills for successful performance in a complex environment requiring intellectual ability to organize work, make and communicate sound decisions, and react successfully to unanticipated events. Students develop learning abilities suitable to continue higher-level intellectual development.

In order to meet the requirements of these options, the faculty looked very carefully at the objectives of each course. Many exercises were performed to verify that course objectives and outcomes were meeting computer information systems departmental goals and College of Business goals. The course objectives and outcomes were also analyzed pursuant to ABET and AACSB accreditation. In Criteria for Accrediting Computing Programs (ABET, 2007), the following statement is made concerning objectives, outcomes, and assessments:

The program enables students to achieve the following attributes by the time of graduation:

a. An ability to apply knowledge of computing and mathematics appropriate to the discipline;

b. An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution;

c. An ability to design, implement and evaluate a computer-based system, process, component, or program to meet desired needs;

d. An ability to function effectively on teams to accomplish a common goal;

e. An understanding of professional, ethical, legal, security, and social issues and responsibilities;

f. An ability to communicate effectively with a range of audiences;

g. An ability to analyze the local and global impact of computing on individuals, organizations and society;

h. Recognition of the need for, and an ability to engage in, continuing professional development;

i. An ability to use current techniques, skills, and tools necessary for computing practice;
An understanding of processes that support the delivery and management of information systems within a specific application environment. (p. 15, 26)

As the faculty considered the objectives of each course, it became apparent that some of the courses currently in the curriculum should be redesigned to meet objectives set forth by the new options. The faculty discovered a need for an introductory level management information systems course which was added to the curriculum. A course used as an introduction to theory and practice of database design and processing was added for the curriculum of EUCS students and will be used to prepare EIS students for the advanced database management systems course. As a result of the analysis step, faculty members became aware of the need for a course in electronic business. A class was included in the curriculum for EIS students to study the standards, tools, and techniques associated with the development of systems to support electronic business. Another void discovered in the analysis step was the absence of a capstone course for seniors. A projects-based course was added to both curriculums to integrate theoretical concepts and practical skills gained in other information systems courses.

The faculty members examined each course in the CIS curriculum to determine if the course should be considered introductory, intermediate, or advanced. As each course was evaluated, the faculty decided two introductory courses should be completed with a grade of C or higher before any intermediate or advanced classes could be attempted. The introductory courses identified were introduction to programming with visual BASIC.NET and the new introductory management information systems class, information systems in organizations.

As new courses were added and current courses were redesigned, the semantics of keeping up with new course numbers was quickly becoming difficult. Under the previous curriculum containing Options I, II, and III, all course numbers ended in a zero or a five (e.g., CIS 330, CIS 315). A numbering system was developed to have numbers of courses which had been redesigned or added to the new curriculum end in a six (e.g., CIS 366, CIS 406) making it easier to recognize courses which had been changed from the previous curriculum.

With the course objectives and outcomes carefully researched, the faculty was ready to present the curriculum to the students in the fall of 2006.

**SYSTEMS IMPLEMENTATION**

The purpose of this phase of the SDLC is to build the new system. In the development of a computer system this phase would include the coding, testing, and documentation of the programs in the system. For the faculty of UNA, this phase included submitting the new courses and redesigned courses to the College of Business Curriculum Committee and then to the university’s Undergraduate Curriculum Committee for approval and inclusion in the course catalog for the 2006-2007 academic year. The transition plans were formalized and submitted with the curriculum proposals. Approval was unanimous at each step of the approval process.

**SYSTEMS OPERATION AND SUPPORT**

The purpose of this phase of the traditional SDLC is to actually use the system designed in the previous steps. In this step it will be determined if the new system is actually meeting the user expectations. The system is continuously maintained and enhanced to meet the needs of the user throughout the useful life of the system.

In this final step of the problem-solving process, the new curriculum was made available to students in the 2006 fall semester. All entering freshmen were placed in either the EIS or the EUCS option. Students entering the CIS program prior to the fall
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of 2006 were given the opportunity to switch their declared major from the previous Option I, II, or III program to the current EIS or EUCS program.

Hoffer, George, and Valacich (2008) say that “users must be provided with ‘point-of-need support’ – specific answers to specific questions at the time the answers are needed” (p. 541). To assist the students and advisors in beginning the new curriculum, many tools were provided to ease the process. A four-year plan sheet was developed to give the student an idea of which courses to take in their freshman, sophomore, junior, and senior years. A flowchart was developed to show a natural flow of progression for a CIS degree including prerequisites. A “transition map” was provided to the faculty advisors and students showing the previous course number and prerequisites for a course as well as the new course number and prerequisites. A document was provided to students and advisors showing all the CIS courses in the curriculum. The course information was color-coded in highlighting to reflect if it was a course required solely for EIS majors, solely for EUCS majors, or required by both programs. Appendix A contains samples of each of these documents.

CONCLUSION

The premise of this chapter and case study is that an information system curriculum is an information system. This chapter is also constructed on the assumption that there is or should be a strong resemblance in the processes associated with developing information systems and with developing information systems curricula. The faculty of the subject university department worked for 2 years on this basis to redesign its major requirements and the courses leading to the major, providing a systematic, complete, and efficient sequence of courses and options. The entire departmental faculty participated in over 60 hours of meetings, workshops, and focus group sessions during the two-year period. Student input and alumni was sought by faculty members preparing for these sessions and faculty members consulted with their many and varied contacts in the employer community concerning issues of importance.

The transitional phase included numerous processes to accommodate the needs of students having made program of study plans passed on old curricula and requirements. Many other academic and support departments of the University were also impacted by the changes and the department has worked tirelessly to manage those impacts and assure a smooth transition for all.

As the new curriculum entered its second semester of use, students were monitored closely by their advisors to ensure a successful completion of the prescribed study. Faculty members are monitoring the courses to see that they are teaching the skills needed by today’s graduate. In the ever-changing field of information technology, it is clear that eventually the curriculum developed in this process will become obsolete and a new curriculum will need to be developed. When that day arrives, following the steps of the SDLC, the faculty will begin again at the systems planning phase and complete the cycle until the new curriculum is operational. Meanwhile, incremental changes will be managed through assessment processes encouraged by the various accrediting bodies and driven by the faculty and its interactions with the other stakeholders in the education process.

REFERENCES


ABET Computing Accreditation Commission. (2007). Criteria for Accrediting Computing Pro-
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KEY TERMS

Curriculum: The prescribed course of study to receive an educational degree.

Preliminary Investigation: Performed by systems analysts to identify the scope and nature of the problem.

Systems Planning Phase: The first phase of the systems development life cycle (SDLC) in which a preliminary investigation will be completed.

Systems Analysis Phase: The second phase of the SDLC where a logical model of the new system is built based upon agreed upon requirements.

Systems Design Phase: The third phase of the SDLC where a plan is developed that will satisfy all the requirements for the new system that were discovered during the analysis phase.

Systems Implementation Phase: The fourth phase of the SDLC where the new system is built by coding, testing and documenting the programs in the system.

Systems Operation and Support Phase: The fifth and final phase of the SDLC where the system designed in the prior phases is continuously maintained and enhanced to meet the needs of the user.

SWOT Analysis: An analytical tool used to identify strengths, weaknesses, opportunities and threats.
UNIVERSITY OF NORTH ALABAMA

Computer Information Systems Major Options

Enterprise Information Systems and End User Computing Systems

2006-2007 Catalog Course Descriptions

CIS 225. (3) Introduction to Programming with Visual BASIC.NET. A study of programming syntax and logic and the fundamental features of current programming languages. Using Visual Basic.Net, students will learn to analyze, program, test, document, and maintain a variety of information systems solutions to business problems. Prerequisite: CIS 125, MA 112.

CIS 236. (3) Information Systems in Organizations. A survey of information systems applications to support business processes, including operational, tactical, and strategic applications. Emerging and pervasive hardware, software, telecommunications, and data resource management technologies are emphasized. Security, ethics, global/international aspects, and systems integration issues are considered using the information systems (IS) framework. Corequisite: CIS 225.

APPENDIX

Table A1.

UNIVERSITY OF NORTH ALABAMA

College of Business

2006 - 2007

COMPUTER INFORMATION SYSTEMS MAJOR OPTIONS
Enterprise Information Systems or End User Computing Systems
Four Year Plan

<table>
<thead>
<tr>
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<th>Second Semester</th>
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<td>FRESHMAN</td>
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<tr>
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<tr>
<td>MA 100 OR MA 112*</td>
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<tr>
<td>Natural Science w/lab**</td>
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<td></td>
</tr>
<tr>
<td>HI 101 or HI 101-H or HI 201</td>
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<tr>
<td>Fine Arts Elective***</td>
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<tr>
<td>SOPHOMORE</td>
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<tr>
<td>EN 231 or EN 233</td>
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<tr>
<td>COM 201 or COM 210</td>
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<tr>
<td>QM 291</td>
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<tr>
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<tr>
<td>MG 330</td>
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<tr>
<td>CIS 225</td>
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<tr>
<td>TOTAL</td>
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continued on following page
*CIS 315. (3) **Advanced Object Oriented Programming.** An advanced programming course with emphasis on object-oriented methodologies and concepts for solving complex business problems. This in-depth study of program control structures and best practices in software development includes advanced elements from object-oriented languages such as JAVA, C++, C#, and Visual BASIC.NET. Prerequisite: CIS 225, 236 (with a grade of C or higher in both).

CIS 330. (3) **Systems Analysis and Design.** An introduction to the strategies and technologies for developing information systems (IS) within organizations. Emphasis is placed on the concepts, methodologies, and tools associated with the analysis, design, and implementation of successful systems. Prerequisite: CIS 225, 236 (with a grade of C or higher in both).

*CIS 350. (3) **Multimedia in Business Reports and Meetings.** A study of the media formats and access technologies necessary to prepare and deliver business presentations enhanced by data from digital media sources. Emphasis is placed on the theoretical and practical aspects of design and implementation of digital multimedia presentations. Exposure to interactive multimedia and virtual meeting formats is included. Prerequisite: CIS 225, 236 (with a grade of C or higher in both).

CIS 366. (3) **Database Development and Management.** An introduction to the theory and practice of database design and processing within the information systems (IS) framework. This includes fundamental design concepts, technical aspects, and components of relational databases and database management systems (DBMS), and use of specific DBMS software. Also covered is the automation of tasks by writing Visual Basic for Applications...
(VBA) code for databases. Emphasis is placed on the importance of the management and effective use of the data resource within an organization. Prerequisite: CIS 225, 236 (with a grade of C or higher in both).

CIS 376. (3) **Web Development.** Introduction to Web development (design and creation) using current standards for client-side content delivery (e.g., XHTML and CSS). Students will learn to create and publish a multi-page, static-content Web site using associated applications. Special focus is given to user interface design, data presentation, and data organization. Prerequisite: CIS 225, 236 (with a grade of C or higher in both).

CIS 406. (3) **Data Communications.** A study of data communications and networking including terminology, components, and models. Communication protocols, network architectures, network security, and network operating systems are included. The management of communications networks is examined. Prerequisite: CIS 330.

*CIS 445. (3) **Advanced Database Management Systems.** An intensive examination of organizational databases, including data validity, reliability, security, and privacy. Structured query languages and report generators, will be emphasized. Distributed databases, data mining, and data warehousing are introduced. The roles of database administrator and data administrator will be explored. A current enterprise DBMS like ORACLE will be used. Prerequisites: CIS 330, 366.

*CIS 446. (3) **Decision Support Using Spreadsheets.** A study of the use of spreadsheet software to analyze and summarize business data. The integration of spreadsheets with other business software and Internet applications is explored. Also includes automation of tasks by writing Visual Basic for Applications (VBA) code for spreadsheets. Emphasis is placed on the importance of the management and effective use of the data resource within organizations. Prerequisite: CIS 225, 236 (with a grade of C or higher in both).

*CIS 456. (3) **Desktop and Web Publishing for Business.** Applications course concentrating on the use of advanced applications for preparing promotional, periodical, informational, and specialty publications with a business emphasis, including desktop publishing concepts. Study of Web site creation and management, using current technologies, and the integration of databases. Includes sound, photo editing, animation, digital cameras, digital video and scanning techniques as they relate to business. Prerequisites: CIS 350, 376.

*CIS 466. (3) **E-Business Technologies and Applications.** A study of the standards, tools, and techniques associated with the development of systems to support electronic business. Various aspects of security, ethics, trans-border data flows, and interoperability will be studied. Included will be technologies, such as PHP, J2EE, and other languages, data management and data communications in an e-commerce environment. Prerequisite: CIS 376, 406, 445.

CIS 486. (3) **Projects in Information Systems.** This course integrates theoretical concepts and practical skills gained in previous information systems courses into a capstone information systems project. This course presents real-world problems through case studies and projects while emphasizing the student’s communication, collaboration, technical, and problem solving skills. Prerequisite: CIS 330, 366, 406, Senior Standing

*Option-specific courses.
Figure A1.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Catalog Prerequisites</th>
<th>Fall 2005 Course Names and Section Numbers, if different from 2006</th>
<th>Fall 2006 Computer Prerequisite Enforcement</th>
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<th>Title</th>
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<td>CIS 125-07</td>
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