

Design of the Information Science and Systems (IS) Curriculum in a Computer and Information Sciences Department

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ABSTRACT

Continuous technological changes have resulted in a rapid turnover of knowledge in the computing field. The impact of these changes directly affects the computer-related curriculum offered by educational institutions and dictates that curriculum must evolve to keep pace with technology and to provide students with the skills required by businesses. At the same time, accreditations of curricula from reviewing organizations provide additional guidelines and standardization for computing science as well as information science programs. One of the areas significantly affected by these changes is the field of information systems.

This paper describes the evaluation and course structure for the undergraduate information science and systems program in the Computer and Information Sciences Department at the University of North Florida. A list of the major required and elective courses as well as an overview of the challenges encountered during the revision of the curriculum is given.

Keywords: Information Science, Information Systems, IS, Computer Science, CS, Curriculum Design, CIS, IS 2002

1. INTRODUCTION

The perspective of an Information Science and Systems (IS) program towards curriculum assessment and revision can be significantly influenced by the location of the program within the educational institution. IS, as a field of academic study, exists with a variety of different names which reflect the historical development of the field, different ideas about how to characterize it, different emphasis when programs were begun using diverse requirements, and the use of standards [1][2][3].

IS programs need to provide courses that fulfill the necessary technical orientation as well as interaction and communication skills needed by employers. More business organizations are hiring information system or science majors for a multitude of computing activities. The technical and organizational expertise of information science graduates to design, develop, and manage information systems functions and systems development (computers, communications, and data) are becoming more in demand and essential to organizational missions. The employment outlook for qualified IS graduates who are prepared to meet the requirements of prospective employers is strong. The demand is expanding as the functional areas of organizations gain more capability in IS. In addition to new graduates, many employees are returning to the academic setting to take training courses or to work towards a degree to learn new techniques and

methodologies in computer technology. To be successful and productive to organizations, graduates need to be qualified and prepared for requirements desired by industry.

Currently, the requirements of businesses are the driving force behind the changes in the information technology field and information systems educational programs. Information science, other than computer science and business requirements, has been influenced strongly by information systems and the curriculum for IS97 [1] and ISCC99 [2]. Computer science subjects from ACM-IEEE Computing Curricula 2001 [4] also have played a major role in IS development and education. The rapid changes in technology have influenced IS resulting in revisions and modifications of curriculums.

A brief description of the IS program in the Computer and Information Sciences (CIS) Department at the University of North Florida (UNF) is reviewed in section 2, and the major required courses are discussed in section 3. Then, the major electives are covered in section 4. Considerations in an IS group and the new IS 2002 curriculum update are presented respectively in sections 5 and 6. Finally, future considerations are given in section 7.

2. OVERVIEW OF IS PROGRAM IN CIS

The Computer and Information Sciences (CIS) Division at the University of North Florida (UNF) was established in 1983. As the number of students increased in response to the demand from the local industries for competent employees, the CIS Division became the Department of Computer and Information Sciences in 1989. Later, a decision was made to merge CIS with the new Electrical Engineering program and to form the College of Computing Sciences and Engineering. At present, the CIS department has 16 full time faculty, 2 full time instructors, 2 full time advisor/instructors, and an abundance of visiting and adjunct teachers.

The IS program is a vital part of the Department of Computer and Information Sciences. Of the 506 CIS registered undergraduates in spring of 2003, approximately 55.93% are enrolled in the IS program, 18.38% in the computer science (CS) program and 25.69% have not yet determined a track. The IS program offers a Bachelor of Science degree in two tracks: Information Systems and Information Science. Both tracks emphasize business application software with computer course work. The number of students for spring of 2003 in Information Science is approximately 117 (23.12%) and Information Systems is 166 (32.81%).

The Information Systems in CIS has an interdisciplinary essence

in that a core selection of Business Administration course work is an integral part of the program. The business courses are in areas of financial accounting, managerial accounting, macroeconomics, business statistics, and calculus. The computing coursework taken for this program is reflective of current computing practices, whether legacy or state-of-art, to support implementation of solutions to business problems. This includes coursework in applications programming, data and file structures, object-oriented design, system design, database design, systems implementation, systems maintenance, networks, and computer communications. Graduates are prepared to embark on careers ranging from software development specialists to information systems managers.

The Information Science program has computer coursework requirements identical to those of the Information Systems program. However, a student majoring in information science may select a minor other than business administration. Depending upon the minor program chosen, graduates are prepared to start in careers in network applications, software development, systems analysis and design, or other more specialized computer-related careers.

The CIS curriculum in the Information Systems program follows the Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems IS97 [1], and ISCC99 [2]. The present IS model curriculum is endorsed by the Association for Computing Machinery (ACM) under the Computing Accreditation Commission (CAC), the Accreditation Board for Engineering and Technology (ABET), the Association for Information Systems (AIS), and the Association of Information Technology Professionals (AITP).

3. MAJOR REQUIRED COURSES

Since its inception, the IS curriculum has undergone a number of modest modifications. The gradual and continual modifications have helped to preserve the consistency in the student study program and faculty members adapt to new technology and changes that are needed by IS [2], [3], [5] and CS curriculum [4]. The IS program has been reviewed and revised by an IS committee several times since its introduction. During the reviews of the program, it was very effective to look at the general structure and then, the course contents from the aspects of concepts and not specific software packages, as well as to move away from purely software or application oriented course or curriculum design. Additionally, it is essential to ensure that foundation and concepts are coupled with practical experiences and contemporary skills [6].

The students in IS program are required to take 120 credit hours to completed the degree. All prerequisite, core, and required courses must be completed with grades of C or better for successful completion of the degree. Students seeking Information Systems degree complete 9 prerequisites courses, 6 core requirements courses, 4 major requirements courses, 4 selected major electives courses, 2 selected minor electives courses, and additional courses as necessary to attain 120 total credit hours. Six of the nine prerequisites courses for the systems degree are in the business area. These courses are Principles of Financial Accounting, Principles of Managerial Accounting, Macroeconomics I & II, Calculus for Business, and Elementary Statistics for Business. All of the business prerequisites courses are 3 credit hours.

Information Science degree students complete 4 prerequisites courses, 4 core requirements courses, 4 major requirements courses, 4 selected major electives courses, 4 minor required courses, 3 elective courses and additional courses as necessary to attain 120 total hours. The diagram in Figure 1 shows the current CIS Information Science and Systems prerequisites, core, and major required courses. To avoid confusion, the major elective courses and requirements for the minor degree are not listed in Figure 1.

The initial prerequisites courses recommended during the freshman year are Calculus for Business or Calculus I and Microcomputer Application Software which is an introduction to the fundamentals of personal computing and commonly used software applications for a personal computer. Figure 1 shows the CIS prerequisites, core, and major required courses with their sequences in the IS program. As shown in Figure 1, each student takes two different groups of programming and data and file structures. Group one is the traditional or legacy path programming and file structures consisting of Introduction to COBOL Programming and File Structures in COBOL. Group two is the new technology path of object oriented programming and data structures in JAVA with courses of Introduction to Object Oriented Programming and Data Structures Using OOP. Either computational structures or discrete mathematics are the prerequisites for both the file and data structures courses.

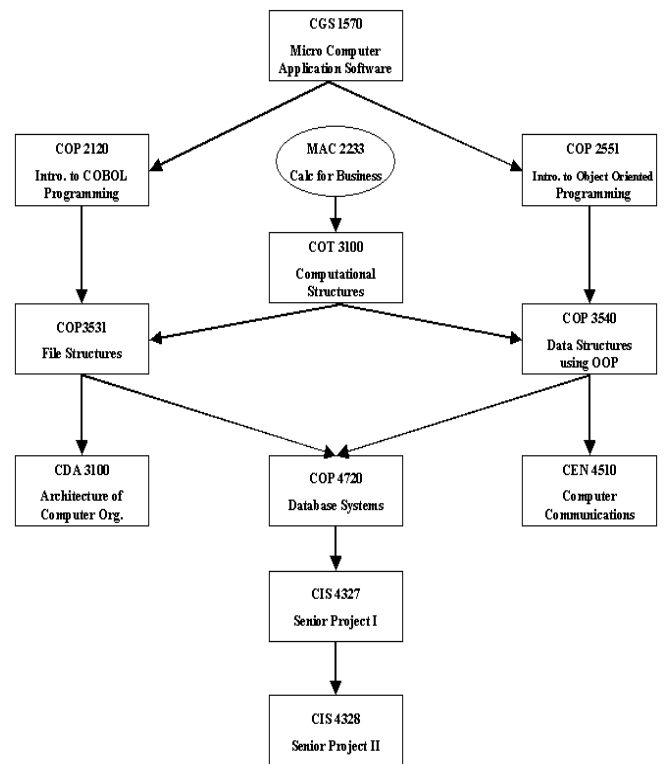


Figure 1. CIS Information Science and Systems prerequisites, core, and major required courses.

Students enroll in the core requirement of Architecture of Computer Organization after file structures and the major requirement of Computer Communications (networking) following data structures. After successful completion of both file structures and data structures, students take the major core requirement of Database Systems. The last two courses in major requirements are Senior Project I and II, which are the same as

system analysis and design I and II course(s). Most of the courses in Figure 1 are 3 credit hours except the structures courses and Architecture of Computer Organization that are 4 credit hours. Descriptions of the courses in Figure 1 with their categories (prerequisites, core, major required) are given in Appendix A.

4. MAJOR ELECTIVE COURSES

The major electives in CIS include Computer Hardware Organization, Interactive Systems Development, Expert Systems/Decision Support, Graphics Systems/Applications, Operating Systems Environments, System Performance/Evaluation, Office Automation/ Human Factors, Networks/Distributed Processes, Database Systems II, Multimedia Systems, and special topics in Information Systems Security, and Geographical Applications. Information Systems or Science students select at least 4 of these major elective courses. All major elective courses except computer hardware organization are 3 credit hours and must be completed with grade of C or better. Descriptions for major elective courses are given in Appendix B.

5. ESTABLISHING OF THE IS GROUP

To establish a continuous IS curriculum revision requires having a permanent committee or an ad hoc committee to monitor the changes. In response to concerns regarding the educational offerings to IS students, the CIS curriculum committee, with a group of faculty members designated as the IS ad hoc committee, oversees the course offerings and the IS curriculum. This committee has a mixture of IS faculty as its members. The CIS curriculum committee monitors concerns by the faculty and instructors regarding course coverage or contents. The IS ad hoc committee proposes revisions to the curriculum for decision making strategies.

Problems and Issues with Modification of Curriculum

It should be noted that the introduction of new technology into an academic setting and the addition of new changes to existing curriculum are not easy tasks. The program review and modifications can be a daunting and prolonged task for an academic program. To better understand the revisions in a program, it is important to understand the foundation and origin of the particular program and its faculty background. Some faculty members resist curriculum changes and new additions. It takes time for the faculty to accept new changes.

Instead of taking a course outline from an existing program used in another institution, it is essential to involve the departmental faculty with knowledge of a subject or topic in the committee to help with development of a course or overall curriculum. If there is not enough expertise in the existing faculty when considering new topics or areas, it may be difficult to add these areas to the curriculum or there may be budget issues for hiring the right faculty member(s). It is important without the necessity of lowering academic standards to develop a curriculum that is more inclusive, sensitive to diversity and cognizant of different aptitudes and motivations of the students [7]. Finding the right staff or providing the necessary technical support in an academic setting can be very difficult and sometimes frustrating. Valuable technical support tends to move on to other positions.

By experience, additional considerations, such as faculty

strengths, domino effect on other courses, appropriate use of technology, and programming languages, that affected the strategies for revision are more subjective and elicit a wide variety of ideas, concerns, and opinions as well as varying degrees of agreement or disagreement. The focus of curriculum meetings should be more toward the structure of the program and general course content instead of the minuscule details of each individual course. This dramatically improves the productivity of the meetings and decreases the intensity of ownership issues on particular courses.

Considerations in Implementation

A group of faculty members, instructors, and advisors from the Department of Computer and Information Sciences conducted a comprehensive review of the Information Science and System (IS) Program to evaluate the program's structure, prerequisites, and course content three years ago. Over the period of a year, the review process and subsequent recommendations involved continual meetings, "spirited" discussions, and persistent emails that resulted in curriculum changes which updated both the courses and the program structure to the present curriculum as described in sections 3 and 4.

However, there were times when the following statement from one of the meetings summarized the general feeling of the members; "Despite overwhelming, boisterous, disapproval and dismay, feelings of disillusionment, and the realization that we would have to endure the weekend "unfulfilled," we adjourned around 12:20." The committee was unable to resolve issues that were subject to outside constraints, such as state guidelines.

The revision experiences encountered by the Information Science and Systems Program at UNF and the resulting curriculum changes meet the demands for qualified IS employees by providing courses that fulfill the necessary technical orientation as well as the interaction and communication skills needed by employers.

6. NEW IS 2002 CURRICULUM UPDATE

The IS 2002 Information Systems model curriculum for undergraduates is designed with eleven courses [5]. There are major similarities between IS 2002 and IS 97 model curriculum. The IS 2002 curriculum assumes that the students have prerequisite knowledge of desktop computing and elementary exposure to the Internet browser, email, word processing, and spreadsheet. Given the initial plan to limit the IS 2002 Curriculum to ten courses with the rapid and significant improvement in general computing literacy of entering students, IS 97.P0 and IS 97.2 were consolidated into a single prerequisite course of IS 2002.P0-Personal Productivity with IS Technology. Due to addition of the Internet since IS 97, a new course (IS 2002.2 Electronic Business Strategy, Architecture and Design) has been added to the IS 2002 model as an Information Systems fundamental course. Addition of the IS 2002.2 course has increased the number of courses from ten in IS97 to eleven courses in IS 2002. The IS 2002 Model Curriculum courses plus Internet course with their categories are listed below. Figure 2 shows the IS 2002 courses and their sequence.

PREREQUISITE:

IS 2002.P0 Personal Productivity with IS Technology

INFORMATION SYSTEMS FUNDAMENTALS:

IS 2002.1 Fundamentals of Information Systems
 IS 2002.2 Electronic Business Strategy, Architecture and Design

INFORMATION SYSTEMS THEORY AND PRACTICE:
 IS 2002.3 Information Systems Theory and Practice

INFORMATION TECHNOLOGY:
 IS 2002.4 Information Technology Hardware and Software
 IS 2002.5 Programming, Data, File and Object Structures
 IS 2002.6 Networks and Telecommunications

INFORMATION SYSTEMS DEVELOPMENT:
 IS 2002.7 Analysis and Logical Design
 IS 2002.8 Physical Design and Implementation with DBMS
 IS 2002.9 Physical Design and Implementation in Emerging Environments

INFORMATION SYSTEMS DEPLOYMENT AND MANAGEMENT PROCESSES:
 IS 2002.10 Project Management and Practice

courses including object oriented components, data warehousing and mining, design, implementation, and software engineering resulting in the graduation of students who are more qualified for business organizations. The CIS Department has had CSAB (presently called CAC) accreditation for the CS program since 1987. The IS program applied for Information Systems accreditation in 2002. After a review process, the program received accreditation in the fall of 2003.

With release of IS 2002, the CIS or IS committee should revise the courses to reflect the changes required by IS 2002 Model Curriculum. The rapid and continual changes in computer technology necessitate the adaptation of curricular offerings in computer-related educational programs to provide students with the current skills and knowledge needed by today's organizations. The review and modifications involved in this process can present a challenging task for an academic program. The integration of the changes into the IS Program continues to require the acceptance and support of teachers, administrators, technicians, and students.

8. REFERENCES

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- [5] Gordon B. Davis, et al., "Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems", <http://www.aisnet.org/Curriculum/index.htm#IS%202002>, 2002
- [6] John P. Dougherty, et al., "Information Technology Fluency in Practice", **SIGCSE Bulletin**, Volume 35, No. 2, June 2003, pp.153-171.
- [7] Michaelangelo Salcedo, "Faculty and the 21st Century Student in USA Higher Education", **SIGCSE Bulletin**, Volume 35, No. 2, June 2003, pp. 83-87.

9. APPENDICES

Appendix A

Prerequisites

MAC 2233 - Calculus for Business (3 credit hours)

Prerequisite: MAC 1105 or MAC 1147, Topics in differential and integral calculus with applications.

CGS 1570 - Microcomputer Application Software (3 credit hours)

Introduction to the fundamentals of personal computing and commonly used software applications for a pc. Includes practical exercises using popular application software packages.

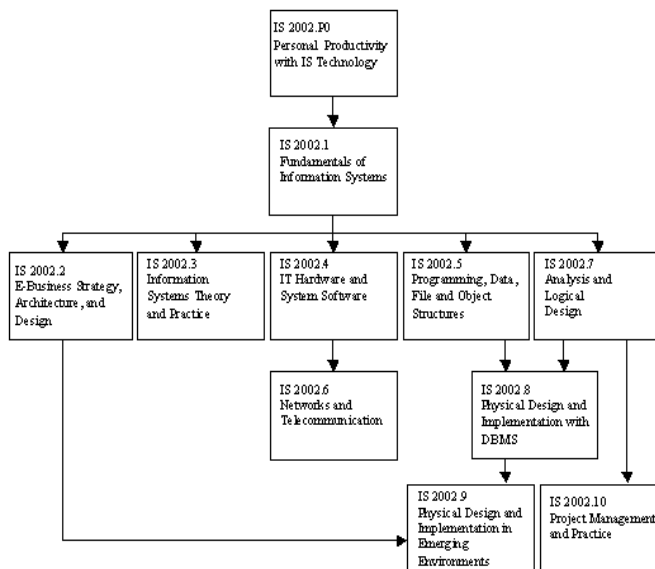


Figure 2. IS 2002 representation of courses and their sequence

The CIS department at University of North Florida needs to incorporate the major IS 2002 changes into the present IS Curriculum. Two revisions can be made to the existing IS program. First, the content of the Microcomputer Application Software course should be enhanced to reflect IS 2002.P0-Personal Productivity with IS Technology. Second, add the IS 2002.2 course Electronic Business Strategy, Architecture and Design as a new required course to the IS Curriculum. At present, IS 2002.2 course is being taught as an elective service course with the name Introduction to the Internet. This course should be modified to become a required Information Systems fundamental course. Existing courses need to be checked for modification and tuning in relationship to the IS 2002 Model Curriculum.

7. LOOKING FORWARD FOR FUTURE CONSIDERATIONS

After the last IS curriculum revision three years ago, the IS program implemented the traditional and new technology path

COP 2120 - Introduction to COBOL Programming (3 credit hours)

Prerequisite: CGS 1570. This course introduces students to the fundamentals of structured programming as well as language structure and capabilities. Students learn about program development, including program definition, pseudocode, flowcharting, coding, testing and debugging. To practice programming skills, students develop COBOL programs to solve "real-world" problems.

COP 2551 - Introduction to Object Oriented Programming (3 credit hours)

Prerequisite: CGS 1570. This course introduces the principles and practices of object oriented (OO) programming. Topics include user interface and problem data classes; class versus instance properties and methods; abstraction; encapsulation; inheritance and multiple inheritance; polymorphism; software design techniques; and problem solving. The concepts are utilized in numerous programming projects.

Core Requirements

CDA 3100 - Architecture of Computer Organization (4 credit hours)

Prerequisites: COP 3531 and COT 3100. Functional systems-level view of computing equipment including organization of components and devices into architectural configurations. Builds an understanding of systems software and combinations of hardware and software in architectural designs. Experience with assembler language and hardware configuration analysis.

COT 3100 - Computational Structures (3 credit hours)

Prerequisite: MAC 2311 or MAC 2233. Applications of finite mathematics to CIS. Sets, relations, functions, and number theory. Algebraic and combinatorial structures. Applications of graphs. Boolean algebra and switching theory, and logic.

COP 3531 - File Structures (4 credit hours)

Prerequisites: COP 2120 and MAC 2233. Prerequisite or corequisite: COT 3100. This course focuses on business-oriented file processing and storage techniques, including tables, searches, Assignments include programming projects to utilize concepts and develop programming skills.

COP 3540 - Data Structures Using OOP (4 credit hours)

Prerequisite: COP 2551. Prerequisite or co-requisite: COT 3100. As a continuation of OOP programming, this course addresses linear and non-linear data structures and techniques. Topics include stacks, queues, trees, indexing techniques, multikey structures, recursion, sorting and searching, hashing, and hash overflow techniques.

Major Requirements

COP 4720 - Database Systems (3 credit hours)

Prerequisite: COP 3531 and COP 3540. This course includes a review of database history, access methods, and data structures. Traditional databases are studied with an emphasis on relational database management system, architecture, operations, SQL, optimization, concurrency and conceptual entity-relationship model. Implementation involves using a commercial relational database management system.

CEN 4510 - Computer Communications (3 credit hours)

Prerequisite: COP 3530 or COP 3540. Communications standards and protocols; transmission fundamentals; network topologies;

data compression and encryption; flow control, bridging, switching, and routing; local and wide-area network protocols; client server and peer-to-peer models; performance measuring.

CIS 4327 - Information Systems Senior Project I (3 credit hours)

Prerequisites: COP 4720. First of a two course senior project on systems development with a significant laboratory component. Students will design a prototype information system in the context of the project team environment employing methodologies of a model software system life cycle including specification, analysis, and design.

CIS 4328 - Information Systems Senior Project II (3 credit hours)

Prerequisite: CIS 4327. The second in a two course senior project with a lecture and significant laboratory components. Students implement a prototype information system in the context of the project team environment employing the methodologies of a model software system life cycle. Capstone course for the Information Systems major.

Appendix B

Major Electives

CAP 4020 - Multimedia Systems (3 credit hours)

Prerequisites: Knowledge of object oriented programming principles and experience with languages such as C, C++, Java, and Visual Basic. This course includes the design and development of multimedia applications using multimedia methods and tools such as presentation managers, drawing software, web page development including HTML, authoring software, and supporting environments. The course requires students to develop their own applications as well as integrating different tools.

CAP 4730 - Graphics Systems and Applications (3 credit hours)

Prerequisite: COP 3531 or COP 3530. Survey of graphics hardware and software with emphasis on applications and user interfacing. Utilization of business graphics packages and graphics utilities. Design and implementation of user-computer dialogue and graphics interface. Exploration of other topics such as image processing, animation and multimedia systems. The student will be required to complete several programming exercises including user-interfacing and 2D (or 3D) graphics projects in a language appropriate for graphics.

CDA 3101 - Introduction to Computer Hardware Organization (4 credit hours)

Prerequisites: COT 3100 and one of COP 2120, COP 2220, or COP 2551. Boolean algebra, switching theory, combinational and sequential circuits, design and minimization techniques, integrated circuits, SSI, MSI, LSI, arithmetic and logic chips, CPU organization, memory organization, microprocessors and logic design.

CDA 4011 - Office Automation / Human Factors (3 credit hours)

Prerequisites: COP 3540 and CDA 3100. This course demonstrates software functionality in modern offices. Topics include electronic document management, clerical and professional support systems, remote offices, and application of new technology in the office. Students will write custom software and apply existing software systems.

CEN 4516 - Networks and Distributed Processing (3 credit hours)

Prerequisite: CEN 4510. Network architecture and protocols in computer communication networks, network elements and topology, switching and routing, data management and security in a distributed environment.

CIS 4100 - System Performance and Evaluation (3 credit hours)

Prerequisite: CDA 3100 and COP 3540. Tools and techniques used in the evaluation of the performance of computing systems, empirical modeling methods, simulation models, deterministic and stochastic methods.

CIS 4301 - Interactive Systems Development (3 credit hours)

Prerequisite: COP 3540. Methodologies for interactive computer systems design. Topics include interfaces from simple menu systems to complex, multitasking, window-driven systems. Laboratory exercises to develop software interfaces ranging from menu systems to window-based systems integrating the interface with data management systems.

CIS 4510 - Expert Systems and Decision Support (3 credit hours)

Prerequisite: COP 3540. Expert systems construction and application. Use of computers in managerial decision making. Examination of problem solving and decision models in relation to the business environment. Practical application emphasizing evaluation of available systems and hands-on experience.

COP 4640 - Operating Systems Environments (3 credit hours)

Prerequisites: CDA 3100 and COP 3540. Introduction to operating systems from an applied point of view. Topics include operating systems configuration, characteristics, and evaluations. Laboratory exercises require students to develop and maintain a multiuser operating system, develop custom system utilities, and evaluate different operating systems configurations.

COP 4722 - Database Systems II (3 credit hours)

Prerequisite: COP 4720. This course examines logical and physical database design, SQL utilization of query language, and CASE design tool for database management system implementation. Other areas of study include client/server system, multi-user databases, DBMS software interfaces, basic database administrator responsibilities, permissions, locking, releasing, granting, and revoking database objects.