COMPUTING CURRICULA
FOR
ASSOCIATE DEGREE PROGRAMS

GUIDELINES FOR

COMPUTER SUPPORT SERVICES

TWO-YEAR COLLEGE
COMPUTING CURRICULA TASK FORCE

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THE ASSOCIATION FOR COMPUTING MACHINERY

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COMPUTER SUPPORT SERVICES

TABLE OF CONTENTS

PART I
CURRICULA STRUCTURE

PART II
CURRICULA KNOWLEDGE UNIT DETAILS

PART III
CURRICULA IMPLEMENTATION SAMPLES

PART IV
SUPPORTIVE INFORMATION

LIST OF FIGURES

LIST OF TABLES

PART I

CURRICULA STRUCTURE

1.0 INTRODUCTION AND CHARTER

In 1990 the Association for Computing Machinery (ACM) awarded the ACM Two-Year College Computing Curricula Task Force preliminary funding to develop curricular guidelines for two-year computing programs. The Task Force identified five curricula areas:

Computer Support Services (CSS)
Computing and Engineering Technology (CET)
Computing for Information Processing (CIP)
Computing Sciences (CS)
Computing for Other Disciplines (COD)

The curriculum area of computer support services is the subject of this report. The intent of these guidelines is to serve the needs of academic institutions (two-year colleges, four-years colleges and universities) offering two-year programs leading to an associate degree. The study *Work Force 2000: Work and Workers for the Twenty-first Century* by the Hudson Institute, states rather emphatically that the shift in job requirements will continue to move from manufacturing to services [1]. *Services, including government services, will account for the three-fourths of the nominal economy, up from 69 percent today.* These guidelines are intended to be helpful to colleges developing graduates for entry into the industry or for continuing academic pursuits in computing support fields.

2.0 GOALS AND OVERVIEW OF THIS REPORT

The challenge for the Computer Support Services Committee was to develop a two-year college curriculum that would address the needs of the industry for the

future. The Committee took into consideration the need to deliver graduates of the two-year educational system who are productive, competent, able to work independently, and who can manage time effectively. The entry level positions in this area span a wide range of hardware, software, system, and interpersonal communication skills, including installation, maintenance, diagnosis, and documentation of computing hardware and software.

Programs at two-year colleges must respond to local conditions and the curriculum offered must consider those needs. Consequently, this report does not contain a single prescription of courses but instead contains recommendations for:

1. A set of curricular and pedagogical considerations that govern the mapping of requirements into two-year programs of study. These include the roles of laboratories, studies from other disciplines, and other educational experiences that combine to make an entire two-year program.

2. A collection of subject matter modules called *Knowledge Units* (patterned after *Computing Curricula 1991*, a joint publication of ACM and the Computer Society of the IEEE [2]). These modules comprise the concepts essential to the body of knowledge necessary to provide computer support in the areas of hardware, software and/or networks.

Because the curriculum guidelines are intentionally flexible, they do not prescribe a single set of courses for a two-year program. They do provide sufficient guidelines, including implementation samples, to allow institutions to style their programs to fit within local institutional constraints, local business needs, current job market opportunities, and articulation agreements with four year programs.

3.0 CURRICULUM GOALS AND PROFILES OF GRADUATES

The Computer Support Services Committee developed guidelines for programs to prepare individuals who can support the full range of computing and communication activities across the spectrum of computer and organization sizes. The graduate of this program may be expected to work without close supervision, to be responsible for tangible and intangible assets, to represent the firm before suppliers and customers, to have access to the firm's confidential information, and to deal with product problems which arise in the modern work place.

3.1 Goals and Objectives

The curriculum guidelines enable graduates to provide support in the areas of networking, hardware, and/or applications. Because of the depth of information in each of these areas, tracks were developed so that a student could concentrate in all areas or could have less depth in one area but more breadth across two or all three areas. The guidelines allow institutions the flexibility to respond to their local community and develop two-year programs, create courses for professional development, and comply with any articulation agreements with other post-secondary institutions.

3.2 Profiles of Graduates

The guidelines in this report identify three program tracks in the area of computer support services: hardware, networking and applications. Upon completion of the program, students will have the skills necessary to support installation, configuration, maintenance and diagnostic services in one or more of the tracks. In addition, graduates will have developed human relation and self-management skills and a recognition of the need for ongoing professional development.

The graduate of a computer support services curriculum should be:

- Skilled in reading, writing, speaking, and conversing.
- Skilled in mathematics through an introduction to calculus.
- Familiar with sociology, the arts, the humanities, and science, consistent with the usual standards for a liberal education.
- introduced to the professional issues of responsibility, ethical behavior, and intellectual property rights.
- Skilled in problem solving and decision making.
- Introduced to business principles and accounting.
- Skilled in the field of choice, with experience in the fields of computer systems, computer applications, and network systems, with specialization in one of these fields. The graduate should understand the principles of modern computer programming theory.
- Experienced in the field of choice through an internship or design project.

3.3 Career Opportunities

The following job titles were identified by the Texas Innovation Network System [3] and are intended to provide some indications of the career paths that graduates of this curriculum might follow.

- Artificial Intelligence Technician
- Computer Control Technician
- Computer Librarian
- Computer Operator
- Database Specialist
- Equipment Operator
- Hardware Maintenance Technician
- Information Technical Support Specialist
- Microcomputer Support Specialist
- Network Cable Installer/Repairer
- Network Systems Technician/Administrator
- Telecommunication Specialist
- Training Certification Specialist

Descriptions of these job titles are included in Part IV of this report.

4.0 COMPONENTS OF CURRICULUM DESIGN

The curriculum is divided into constituent subject areas, each of which is divided into knowledge units. Knowledge units are then combined to form courses within the curriculum.

4.1 Subject Areas and Knowledge Units

There are seven subject areas defined for computer support services. Each subject area is divided into a set of knowledge units which represents the core of the body of knowledge within the curriculum. The seven subject areas are:

- Analysis and Management
- Hardware
- Networks
- Operating Systems
- Social, Professional and Ethical Issues
- Software Methodology

- Standard Applications

Subject areas are listed alphabetically and not necessarily in the order of presentation. The details of the knowledge units are included in Part II of this report. It is intended that these units will be mapped into courses as determined by individual institutions. Sample courses are presented in Part III.

4.2 Emphasis, Depth and Underlying Themes

Courses are composed of knowledge units which are included to different emphases and depths depending on the course and its position within a track. In introductory courses a knowledge unit might be included with more breadth coverage and less depth, while at a more advanced level the knowledge unit coverage could go to greater depth.

Within courses, each knowledge will contain a listing of its emphasis. The emphasis is expressed in terms of the three paradigms of *Theory (T), Analysis (A) and Design (D).* The complete explanation and usage of these paradigms are included in Part III of this report.

Within courses, each knowledge unit is also given a depth of knowledge in terms of the integers 1 through 5. The complete explanation and usage of this *depth indicator* is also included in Part III of this report.

Certain fundamental concepts recur throughout the discipline and play an important role in the design of individual courses and the whole curricula. These fundamental concepts are referred to as *underlying themes*. The underlying themes provide a cohesiveness that help to tie the individual knowledge units together. The details of the underlying themes for computer support services are included in Part III of this report.

5.0 DEFINITION OF THE CURRICULUM

The sections that follow define the subject areas for the computer support services curriculum, as well as a discussion of the curriculum options.

5.1 The Seven Subject Areas

Each of the seven subject areas is distinguished from the others by the existence of a significant and active research community and application domain. A person working in the computer support services field must be familiar with these areas. The subject areas for the computer support services curriculum are:

Analysis and Management (AM)
This subject area deals with the skills necessary to discover, analyze and resolve problems using systemic processes. This topic also includes project management, covering resource allocation and project definition, planning an implementation. Fundamental questions include: How can goal alignment occur within the basic organizational situations? What skills are necessary for effective interpersonal presentations, negotiations, leadership, tradeoffs, resource allocation, and team building? What are the different problem solving techniques and styles?

Hardware (HW)
This subject area covers the physical resources of a computing system. Fundamental questions include: What are the fundamental hardware components of a computing system? How are the components constructed? How are the components integrated? How are the integrated components managed?

Networks (NW)
This subject area covers the hardware, software and their configurations necessary to networks and the transmission and sharing of data. Fundamental questions include: Why network? What are the basic types of networks? How are networks designed, constructed and administered?

Operating Systems (OS)
This subject area emphasis the mechanism which coordinates the hardware resources with the execution of a program. Fundamental questions include: At each time scale in the operation of a computer system, what are the visible objects and permissible operations on them? How can interfaces be organized so that users deal only with abstract versions of resources and not with physical details of hardware? What are

effective control strategies for job scheduling, memory management, communications, access to software resources, communication among concurrent tasks, reliability, and security? How should distributed computations be organized so that many autonomous machines connected by a communications network can participate in a computation?

Social, Professional and Ethical Issues (SP)
This subject area deals with the basic tenets inherent to becoming a professional in the computing industry. Fundamental questions included: What skills are necessary to set, strive for and achieve personal and/or organizational goals? What is the responsibility of the individual to society? What is the responsibility of society to the individual? What is the responsibility of the individual to the profession?

Software Methodology (SM)
This subject area emphasizes the methods used to design and implement a set of instructions to produce a desired outcome from a computer system. Fundamental questions included: For given classes of problems, what are the best designs? At any point in time, what are the current and evolving technology and standards? How much storage and time are required? What is the best way to access the data?

Standard Applications (SA)
This subject area covers the software packages in common use that need to be installed and configured for different processing environments. Fundamental questions include: What are the major relevant applications? How are they used, installed and configured? What issues are involved in administration of these applications in the different processing environments?

5.2. Building the Curriculum

There are three distinct tracks in the computer support system curriculum: hardware, software, and networks. This provides the student with an opportunity to either specialize in an area or develop breadth in the subject area. Different tracks may contain common knowledge units. However, the expected exit competencies for each of the knowledge units may differ depending on the curriculum track pursued by the student. Expected exit competencies of the knowledge units within each track are shown in Part III of this report.

5.3 Social and Professional Context

Students need to understand the basic cultural, social, legal and ethical issues inherent in the discipline of computing. They should also understand the history, the current situation, and trends in the discipline of computing. They should also understand their individual roles in this process, as well as appreciate the philosophical questions, technical problems, and aesthetic values that have played an important part in the development of the discipline.

Students also need to develop the ability to ask serious questions about the social impact of computing and to evaluate proposed answers to those questions. Future practitioners must be able to anticipate the impact of introducing a given product or service into an environment. Will that product or service enhance or degrade the quality of life? What will the impact be upon individuals, groups, institutions and society at large?

Finally, students need to be aware of the basic legal rights of software and hardware vendors and users, and they also need to appreciate the ethical values which are the basis for those rights. These future practitioners must understand the responsibility that they will bear for what they do, and the possible consequences of failure to maintain appropriate professional standards.

6.0 REQUIREMENTS FROM OTHER DISCIPLINES

A strong background in algebra is the prerequisite for the study of mathematics in computing programs. Programs should include courses from college algebra through precalculus. Additional courses in logic or mathematics such as, calculus and discrete mathematics should also be included when it best meets the needs of the program and the industry it serves.

Laboratory-based science courses are an important part of a computing program. These courses enable students to acquire a fundamental knowledge about nature and its phenomena. Courses should emphasize the understanding, measurement, and quantitative expression of physical processes. Laboratory work, including experimentation, observation, measurement and report writing, should be a required part of the study of science.

Business courses in the areas of accounting and finance are necessary both for computing applications and to provide a career path to the position of management of resources.

Good oral and written communication skills are necessary for all college graduates, including technically trained individuals. The student should be able to effectively communicate technical findings, thoughts and philosophies.

Associate degree programs should include course work in English composition, including both written and oral presentation, and technical writing. Furthermore, writing must be integrated into technical courses. Student reports must be neat, grammatically correct and lucid. Students should also be given an opportunity to make oral presentations to their peers. Furthermore, the ability to read and assimilate technical literature is an important skill that will enable students to keep current in their field. Students should be encouraged to read technical publications and to use manufacturer's literature and data books in support of their laboratory assignments.

With the internationalization of markets, it is not sufficient that students be familiar only with the rich cultural heritage of the United States. They should also understand other peoples, their cultures and languages. Students must also sense the responsibility they have to protect society and the environment in which they live. It is important therefore, to include studies in the areas such as history, sociology, and political science.

7.0 RESOURCES

Two-year colleges offering degree programs in computer support services need to give careful thought to the commitment requirements for faculty, staff, laboratory facilities, and library facilities. This section summarizes some resource recommendations which impact curriculum development.

7.1 Faculty and Staff

The nucleus of the faculty should be full-time, tenured, or tenure-track faculty with suitable education, teaching experience, and professional experience in the field. These faculty should be encouraged to maintain currentness in this fast-moving field by research, consultation, sabbaticals and other customary

means. Adjunct faculty and industry contacts may be used to supplement the faculty nucleus, consistent with the policies of the institution.

Staff employees will be required to operate and maintain laboratory computing systems. Whether these employees are dedicated to laboratory systems or dealing with other computing systems in the institution, they must have the appropriate education and experience necessary to support these types of technological programs. Serious efforts must be made to maintain and advance their technological competencies.

Laboratories should be staffed with specialists who can not only monitor the appropriate use of equipment and software, but also assist students with the technical aspects of assigned laboratory work. They should not be used to substitute for faculty instruction.

7.2 Laboratory Resources

Laboratory equipment should consist of a suitable number of personal computers or workstations. At least some should be connected by a local area network. Access to external networks, use of personal computers, workstations, or terminals, a wide range of software resources, must be available.

Given the dynamic nature of the computing field, the institution must periodically update and revise a strategic facilities plan, so that the laboratory equipment will be kept aligned with computing equipment used by local industries. A plan for laboratory improvement should be kept and maintained which includes buying or leasing equipment and software, licenses and contracts, and regular maintenance. This plan should also provide technical support for hardware and software.

Laboratories should not only be scheduled for *closed* laboratory sessions, but should also be freely accessible at other times so that students have access to facilities and resources to complete their assignments in a timely fashion. In light of protection and safety, the choice between providing an environment for exploring a subject without constraints and restricting the task so that it limits such free exploration should be conscientiously addressed in designing open and closed laboratory assignments.

7.3 Library Support

Library facilities to support this program should include a suitable collection of reference materials and subscriptions to appropriate trade press publications. The library should support institutional efforts to develop a strategic plan for accessing information through electronic means. The plan should address remote access, video tape, and interactive video, so that over time the library can access current resources on media methods.

8.0 PROGRAM ISSUES

Computer support service areas in the future will probably continue to have a wide range of organizational sizes, which in turn will have differing technological requirements. Consequently, knowledge units configured into instructional modules may well be different in coverage and emphasis at various institutions.

8.1 Institutional Core

Institutional core courses will continue to be an important part of any suggested curriculum guidelines. The recommendations for institutional core courses offered in these guidelines should be chosen to highlight the work perspective by orienting the student in the political, economic and social milieu extant within the overall society. These courses should also facilitate student proficiency in mathematics, sciences, autonomy, teamwork, and speaking/listening skills.

In addition, there are essential general education competencies that should be present in the curriculum. General education objectives should be part of the institutional core and developed and reinforced in the balance of the curriculum. General education should include communication skills, awareness of the social and historical aspects of the discipline, understanding of the business environments, and effective problem-solving and decision-making skills.

8.2 Computing Technology Core

There are two subject areas in the field of computer support services which are not directly related to the computer. The knowledge units in the subject areas of *Analysis and Management* and *Social, Professional and Ethical Issues* would emphasize professional development including decision-making, ethics, research and problem solving skills. In addition, the curriculum includes a recommendation for a capstone course. This course would attempt to integrate

the knowledge units from across the specializations. One of the many ways this might be accomplished would be via an appropriate industrial internship experience. The student's educational experience is best rounded into form with a controlled work experience which allows the student to test what has been learned, to work in a responsible way in a normal work group environment, and to have this experience while retaining access to the faculty for guidance.

The rest of the subject areas in the field of computer support services have three separate emphases, which are: computer systems which encompass hardware and operating systems, computer applications which include software and applications, and network systems. The knowledge units within these subject areas provide the introduction to each of the areas as well as appropriate in-depth material relevant to the local environment. Finally, all students will learn structured programming in the language suitable to the current requirements in the computing industry. After mastering these core computing knowledge units, the student would advance into specialization in one or more of these areas.

8.3 Computer Support Services Specialization Areas

Students in computer support services can select an emphasis from one or more of three areas in their specialization. These emphases are: a) computer systems, hardware and operating systems; b) computer applications, software and applications; and c) network systems. Three courses, composed of appropriate knowledge units, are available in each of the emphases. Students may opt to generalize and take these advanced courses from more than a single specialty area. A suggested curriculum structure is outlined in the Part III.

8.4 Articulation

This program of instruction anticipates that graduates will complete their education through the associate degree level and then enter the employment market. While articulation with baccalaureate programs has not been a major focus for this program, the institution is encouraged to develop articulation agreements with appropriate four-year institutions.

8.5 Methodology of Instruction

The delivery of instruction in the computing-related areas needs to evolve from

the traditional lecture method to methods which allow the student to become active in the learning process. Ideas for other methods include:

- Doing team projects
- Learning new material and teaching that material
- Solving campus and business problems for course projects
- Using interactive training devices
- Using multimedia in the classroom to present or review material
- Exploring the subject through field trips
- Researching a subject using equipment networked to outside databases
- Communicating with others in distant places to share information and resources

All of these suggested methods expect the student to be a self-directed learner, a *doer* or *creator* of information, not a passive receiver. The memorization of information does not guarantee an understanding of that information, nor does it mean that the person will know how to use or when to use that information in the work place to solve problems.

With appropriate use of current and future technology, students will be prepared to: learn, solve problems, communicate with others, get along with diverse personalities, think logically, and envision the future.

8.6 Assessment

Recommendations for the design and content of assessment programs are beyond the scope of this report. However, this is an important area for any institution that wishes to maintain a quality, up-to-date program.

9.0 SERVICE COURSES

A role of the computer support services faculty is to serve the needs of other disciplines within the college, local industry, and the community.

9.1 Service to Other Disciplines

The computer support services faculty are valuables resources for other departments within the college. They are frequently called upon to provide the development and instruction for computer-related courses within the curriculum of another department. In addition, given the nature of the curriculum, the faculty could also be a resource for the college with its long and short term computer planning. Being able to offer this service strengthens the position of the department and enhances its role within the structure of the college.

9.2 Needs of Industry and the Community

Since one of the roles of the two-year college is to help serve the needs of the local industry and the community, the computer support services faculty must be especially sensitive to the needs these needs and receptive to meeting them. These needs could be met through regular credit-bearing courses, elective courses, or special programs designed to meet a specific need.

10.0 CONCLUSION

Successful adaptation to community needs will determine the viability of any curriculum offered by an institution. Technology will continue to make changes in all organizations and aspects of society. The recommendations presented in this report are intentionally flexible in anticipation of technological changes. Institutions should feel comfortable modifying these guidelines, as the situation dictates.

In conclusion, this part of the document lays a foundation for designing and implementing a computer support services curriculum based on a set of knowledge units that the program should incorporate. Because this foundation is based on a contemporary and broad definition of the field, it should encourage programs to include an emphasis and a depth of subject matter coverage. Also, because the foundation is built with knowledge units rather than a single prescribed set of courses, it allow implementations to be developed in a wide range of institutional settings.

The details of the knowledge units are included in Part II of this report. An example implementation of this curriculum is given in Part III.

This report was prepared by the Computer Support Services Committee of the Two-Year College Computing Curricula Task Force of the Association for Computing Machinery. The Steering Committee of the Task Force is appreciative of the many individuals and organizations that supported this project. A listing of their names appears in the Executive Report of the Task Force.

PART II

CURRICULA KNOWLEDGE UNIT DETAILS

1.0 OVERVIEW OF KNOWLEDGE UNITS

The following sections contain the details of the knowledge units (KU) for the computer support services curriculum. Each knowledge unit has a format as outlined in Figure II-1:

SUBJECT NAME **ANALYSIS AND MANAGEMENT**

KNOWLEDGE UNIT TAG AND NAME **AM1: APPRAISING SITUATIONS**

DESCRIPTION The result of appraising a situation should provide the tools and techniques to assist in clarifying and assessing concerns. It can be used to plan a work-day or a week, or to work with others to set directions.

TOPICS Minimum number of hours: 5

1. Recognizing concerns
2. Separating concerns
3. Setting priorities
4. Locating resolution process
5. Planning resolution

PREREQUISITES None

REQUISITE FOR AM2

Figure II-1 Model of Knowledge Unit

There are several reasons for this form of presentation. First, a level of detail, with examples, is required to effectively communicate the concepts. While the examples will change over time it is anticipated that the knowledge units will evolve slower. Second, it is imperative to provide a common framework to ensure completeness during subsequent analyses and utilizations. Without a structure it would be possible to overlook some critical detail while developing a flexible curricula. Finally, the detail format provides the opportunity for faculty groups to tailor courses to meet local needs which is, after all, the basic intention of the flexibility built into the curricula.

The *Subject Name* identifies the topic category and is followed by a two-letter code in parentheses. For example the subject name:

OPERATING SYSTEMS (OS)

identifies the subject category and its tag code. This tag code is then used to identify the knowledge units within this subject area. The *Knowledge Unit Tag and Name* identifies the particular knowledge unit and has the format

Letter-1 Letter-2 Integer : Knowledge Unit Name

Letter-1 and letter-2 identify the subject area and the integer identifies a particular KU under a subject area. The *Description* of a knowledge unit is a brief statement describing the synopsis of the information of the knowledge unit. The *Topics* identify the particular concepts to be addressed. *Prerequisites* and *Requisite For* show how an individual knowledge unit relates to other knowledge units within the curriculum.

2.0 SUBJECT AREAS AND RELATED KNOWLEDGE UNITS

Each of the seven subject areas is distinguished from the others by the existence of a significant and active research community and application domain. The following knowledge units within subject areas have been identified for the computer support services curriculum.

Analysis and Management (AM)

AM1: Appraising Situations
AM2: Decision Analysis
AM3: Potential Problem Analysis
AM4: Problem Analysis
AM5: Project Management - Definition
AM6: Project Management - Planning
AM7: Project Management - Implementation and Evaluation

Hardware (HW)

HW1: Standards
HW2: Architecture and Processors
HW3: Chips and Boards
HW4: Peripherals
HW5: Network Hardware and Cabling
HW6: Computational Site Environment
HW7: Connectivity devices

Networks (NW)

NW1: Network Architecture, Topologies and Access
NW2: Network Transmission and Media
NW3: Connectivity and Interoperability
NW4: Network Applications
NW5: Network Administration

Operating Systems (OS)

OS1: Operating Systems Fundamentals
OS2: Process Management
OS3: Memory Management
OS4: Auxiliary Storage Management
OS5: Security
OS6: Open Systems
OS7: System Administration

Social, Professional and Ethical Issues (SP)

SP1: The Role of the Professional in Society
SP2: Responsibilities to Society
SP3: Professional Ethics
SP4: Self-managed Employees
SP5: Intellectual Property

Software Methodology (SM)

SM1: Fundamental Problem Solving Concepts
SM2: Software Development Process
SM3: Software Requirements and Specifications
SM4: Software Design and Implementation

Standard Applications (SA)

SA1: Text Processors
SA2: Numeric Processors
SA3: Image Processors
SA4: Data Organizers
SA5: Communication Processors
SA6: Audio Processors

3.0 DETAILS OF KNOWLEDGE UNITS

This section contains the details of the knowledge units within the seven subject areas for the computer support services curriculum. The details follow the format discussed in Section 1.

Knowledge units within the sane subject area are separated by a single bar; knowledge units in different subject areas are separated by double bars.

SUBJECT NAME **ANALYSIS AND MANAGEMENT**

KNOWLEDGE UNIT TAG AND NAME **AM1: APPRAISING SITUATIONS**

DESCRIPTION The result of appraising a situation should provide the tools and techniques to assist in clarifying and assessing concerns. It can be used to plan a work-day or a week, or to work with others to set directions.

TOPICS Minimum number of hours: 5

1. Recognizing concerns
2. Separating concerns
3. Setting priorities
4. Locating resolution process
5. Planning resolution

PREREQUISITES None

REQUISITE FOR AM2

SUBJECT NAME **ANALYSIS AND MANAGEMENT**

KNOWLEDGE UNIT TAG AND NAME **AM2: DECISION ANALYSIS**

DESCRIPTION Within organizations and in personal situations, there is frequently a need to choose a course of action, to establish the criteria for selection or to assess a recommendation presented for approval. Decisions need to be based on thorough analysis of relevant information.

TOPICS Minimum number of hours: 6

1. Stating decisions
2. Establish and classifying objectives
3. Establishing and evaluating alternatives
4. Assessing the risks
5. Making the final choice

PREREQUISITES AM1

REQUISITE FOR AM3

SUBJECT NAME **ANALYSIS AND MANAGEMENT**

KNOWLEDGE UNIT TAG AND NAME **AM3: POTENTIAL PROBLEM ANALYSIS**

DESCRIPTION Once decisions are made to pursue a course of action the decision must be implemented. Usually the plan is implemented in a very dynamic environment. Potential problem analysis provides a conscious approach to help improve planning and give greater assurance of successful implementation.

TOPICS Minimum number of hours: 5

1. Anticipate potential problems
2. Anticipate likely causes
3. Selecting preventive actions
4. Selecting contingent actions

PREREQUISITES AM2

REQUISITE FOR AM4

SUBJECT NAME **ANALYSIS AND MANAGEMENT**

KNOWLEDGE UNIT TAG AND NAME **AM4: PROBLEM ANALYSIS**

DESCRIPTION Discussion of the complete problem solving process and analysis of a problem from defining to finding and verifying true cause.

TOPICS Minimum number of hours: 7

1. Finding the deviation
2. Specify the problem (identify distinctions, identify what has changed, develop possible causes)
3. True cause (test for probable causes, verify the cause)

PREREQUISITES AM3

REQUISITE AM5

SUBJECT NAME **ANALYSIS AND MANAGEMENT**

KNOWLEDGE UNIT TAG AND NAME **AM5: PROJECT MANAGEMENT - DEFINITION**

DESCRIPTION The definition phase of a project should be clearly thought out to identify and clarify the projects purpose.

TOPICS Minimum number of hours: 6

1. Project purpose
2. Project objectives
3. Work breakdown structure (WBS)
4. Resource requirements
5. Project management discussion

PREREQUISITES AM4

REQUISITE FOR AM6

SUBJECT NAME **ANALYSIS AND MANAGEMENT**

KNOWLEDGE UNIT TAG AND NAME **AM6: PROJECT MANAGEMENT - PLANNING**

DESCRIPTION Once the project has been defined the plan should be developed. The planning phase is to organize the projects task and the resources within realistic time frames.

TOPICS Minimum number of hours: 6

1. Responsibility assignment matrix (RAM)
2. Project planning tools - work breakdown structure, Gantt or bar charts, network diagrams, critical path method (CPM), project education and review techniques, and software programs
3. Project planning enhancement techniques - potential problem analysis, potential opportunity analysis
4. Resource manager scheduling - resource manager supports project. Required to insure resources are available when needed

PREREQUISITES AM5

REQUISITE FOR AM7

SUBJECT NAME **ANALYSIS AND MANAGEMENT**

KNOWLEDGE UNIT TAG AND NAME **AM7: PROJECT MANAGEMENT - IMPLEMENTATION AND EVALUATION**

DESCRIPTION The implementation phase is the phase where the actual project begins and works to completion.

TOPICS Minimum number of hours: 6

1. Project monitoring and control
2. Project modification
3. Performance analysis
4. Closeout and evaluation
5. Project management and discussion

PREREQUISITES AM6

REQUISITE FOR None

SUBJECT NAME **HARDWARE**

KNOWLEDGE UNIT TAG AND NAME **HW1: STANDARDS**

DESCRIPTION Discussion of different standard-setting organizations for hardware. A discussion of data representation.

TOPICS Minimum number of hours: 3

1. OSI, IEEE, ISO, and CCITT standards
2. Standard setting bodies and their proclamations
3. Conformance, API's
4. Data representation: numeric (binary, octal, hexadecimal), and non-numeric (text, alphanumeric)

PREREQUISITES None

REQUISITE FOR HW2

SUBJECT NAME **HARDWARE**

KNOWLEDGE UNIT TAG AND NAME **HW2: ARCHITECTURE AND PROCESSORS**

DESCRIPTION Discussion of hardware architecture implementations and processors used in the different architectures.

TOPICS Minimum number of hours: 3

1. Microcomputers
2. Minicomputers
3. Mainframes
4. Instruction sets

PREREQUISITES HW1

REQUISITE FOR HW3

SUBJECT NAME **HARDWARE**

KNOWLEDGE UNIT TAG AND NAME **HW3: CHIPS AND BOARDS**

DESCRIPTION Discussion of the hardware components of computer system.

TOPICS Minimum number of hours: 4

1. Architecture
2. Microprocessors
3. Chip configuration and structure
4. Memory boards including chip sizes
5. Mother boards
6. Coprocessor boards - math, graphics, FAX, modems, voice
7. Controller cards
8. Network interface cards

PREREQUISITES HW2

REQUISITE FOR HW4

SUBJECT NAME **HARDWARE**

KNOWLEDGE UNIT TAG AND NAME **HW4: PERIPHERALS**

DESCRIPTION Discussion of the hardware used for input, output, or storage.

TOPICS Minimum number of hours: 4

1. Input devices (keyboard, mouse, scanners, pens, bar code readers, credit/debit/smart cards, voice, video, gloves, joysticks, joystrings, etc.)
2. Output devices (voice, speaker output devices, printers and plotters, printer sharing units, SCSI interface)
3. Multimedia (television, music)
4. Storage (tape, disk, CD-ROM)

PREREQUISITES HW3

REQUISITE FOR HW5, OS4

SUBJECT NAME **HARDWARE**

KNOWLEDGE UNIT TAG AND NAME **HW5: NETWORK HARDWARE AND CABLING**

DESCRIPTION Discussion of network layouts and the buses and cables used.

TOPICS Minimum number of hours: 9

1. Cable type
2. Transmission techniques (BASEBAND, BROADBAND)
3. Topologies (bus, hierarchical, ring, star)
4. Equipment (cable trays, panduit, wall plugs)

PREREQUISITES HW4

REQUISITE FOR HW6, HW7, OS7

SUBJECT NAME **HARDWARE**

KNOWLEDGE UNIT TAG AND NAME **HW6: COMPUTER FACILITY**

DESCRIPTION Discussion of all site conditions that could potentially affect the continuous operation of a computer system. This discussion should also include the conditions affecting the efficiency/health of the individuals who interact with the systems.

TOPICS Minimum number of hours: 4

1. Environmental requirements
2. Power requirements and power supplies
3. Ergonomic issues
4. Structural capacities
5. Local codes

PREREQUISITES HW5

REQUISITE FOR OS7

SUBJECT NAME **HARDWARE**

KNOWLEDGE UNIT TAG AND NAME **HW7: CONNECTIVITY DEVICES**

DESCRIPTION Discussion of devices used to connect computers, LANs, WANs. For example: baluns, routers, and bridges.

TOPICS Minimum number of hours: 3

1. Baluns
2. Multiplexors, MODEMS, CODECS
3. Switches, gateways, bridges, routers, brouters, repeaters
4. Test and maintain equipment (protocol analyzers)

PREREQUISITES HW5

REQUISITE FOR None

SUBJECT NAME **NETWORKS**

KNOWLEDGE UNIT TAG AND NAME **NW1: NETWORK ARCHITECTURE, TOPOLOGIES AND ACCESS**

DESCRIPTION The physical and virtual structures of data communication networks including layering, communication paths and access methods.

TOPICS Minimum number of hours: 8

1. Topologies
2. Architectures
3. Layering
4. Standards and protocols

PREREQUISITES OS6, OS7

REQUISITE FOR NW2

SUBJECT NAME **NETWORKS**

KNOWLEDGE UNIT TAG AND NAME **NW2: NETWORK TRANSMISSION**

DESCRIPTION A discussion of the techniques and technologies necessary for data transmission.

TOPICS Minimum number of hours: 10

1. Signals
2. Patterns
3 Error detection, correction
4. Media
5. Equipment
6. Speed of transmission

PREREQUISITES NW1

REQUISITE FOR NW3

SUBJECT NAME **NETWORKS**

KNOWLEDGE UNIT TAG AND NAME **NW3: CONNECTIVITY AND INTEROPERABILITY**

DESCRIPTION An introduction to the requirements for connecting devices to networks and/or other devices and ensuring their ability to correctly exchange information with each other.

TOPICS Minimum number of hours: 11

1. Equipment
2. Software
3. Media
4. Type (peer-to-peer, peer-to-host)

PREREQUISITES NW2

REQUISITE FOR NW4

SUBJECT NAME **NETWORKS**

KNOWLEDGE UNIT TAG AND NAME **NW4: NETWORK APPLICATIONS**

DESCRIPTION A discussion of the applications and functions generally supported on networks or network nodes.

TOPICS Minimum number of hours: 10

1. Electronic/voice/multi-media mail
2. File sharing
3. Dial-in access
4. Backups
5. Resource sharing
6. Software control
7. Security and authentication

PREREQUISITES NW3

REQUISITE FOR NW5

SUBJECT NAME **NETWORKS**

KNOWLEDGE UNIT TAG AND NAME **NW5: NETWORK ADMINISTRATION**

DESCRIPTION The processes necessary to support physical installation of a network.

TOPICS Minimum number of hours: 5

1. Access control and security
2. Resource management
3. Installation, configuration, modification
4. Network operations analysis
5. Physical and virtual connections
6. Standards and licensing
7. Disaster recovery
8. Addressing protocols

PREREQUISITES NW4

REQUISITE FOR None

SUBJECT NAME **OPERATING SYSTEMS**

KNOWLEDGE UNIT TAG AND NAME **OS1: OPERATING SYSTEMS FUNDAMENTALS**

DESCRIPTION Discussion of different operating systems.

TOPICS Minimum number of hours: 6

1. Microcomputer operating systems
2. Minicomputer operating systems
3. Mainframe operating systems
4. Network operating systems

PREREQUISITES None

REQUISITE FOR OS2, OS6, OS7

SUBJECT NAME **OPERATING SYSTEMS**

KNOWLEDGE UNIT TAG AND NAME **OS2: PROCESS MANAGEMENT**

DESCRIPTION Discussion of the control of all the activities within the CPU.

TOPICS Minimum number of hours: 3

1. Processes
2. Concurrency
3. Scheduling
4. Multitasking and multiprocessing

PREREQUISITES OS1

REQUISITE FOR OS3

SUBJECT NAME **OPERATING SYSTEMS**

KNOWLEDGE UNIT TAG AND NAME **OS3: MEMORY MANAGEMENT**

DESCRIPTION Discussion of the diversity of memory organization and management schemes with a special emphasis on the virtual memory schemes of paging and segmentation.

TOPICS Minimum number of hours: 3

1. Primary memory
2. Virtual memory
3. Extended memory
4. Expanded memory
5. Cache memory

PREREQUISITES OS2

REQUISITE FOR OS4

SUBJECT NAME **OPERATING SYSTEMS**

KNOWLEDGE UNIT TAG AND NAME **OS4: AUXILIARY STORAGE MANAGEMENT**

DESCRIPTION Discussion of the diversity of auxiliary storage media, their operational characteristics, and their storage capacities and retrieval methods. Examples are: tape, floppy disk, hard disk, laser optical disks.

TOPICS Minimum number of hours: 2

1. File and directories
2. Device management - disk, tape, CD-ROM

PREREQUISITES OS3, HW4

REQUISITE FOR OS5, OS6

SUBJECT NAME **OPERATING SYSTEMS**

KNOWLEDGE UNIT TAG AND NAME **OS5: SECURITY**

DESCRIPTION Discussion of the importance of achieving secure computing and communication systems, the difficulties of achieving security in increasingly open systems environments. Topics include worms, viruses, vaccines, penetrating operating systems, security procedures, and encryption techniques.

TOPICS Minimum number of hours: 4

1. Backup and recovery
2. Disaster planning
3. Authentication
4. Encryption
5. Viruses
6. OS penetration

PREREQUISITES OS4

REQUISITE FOR OS7

SUBJECT NAME **OPERATING SYSTEMS**

KNOWLEDGE UNIT TAG AND NAME **OS6: OPEN SYSTEMS**

DESCRIPTION Discussion of the shift away from proprietary architecture and to open systems architecture.

TOPICS Minimum number of hours: 2

1. Standards and standards' organizations
2. X/OPEN
3. Open Software Foundation

00 4. UNIX International

5. Corporation for Open Systems International

PREREQUISITES OS4

REQUISITE FOR NW1

SUBJECT NAME **OPERATING SYSTEMS**

KNOWLEDGE UNIT TAG AND NAME **OS7: SYSTEM ADMINISTRATION**

DESCRIPTION Discussion of the issues in managing a network operating system.

TOPICS Minimum number of hours: 4

1. Complete system management
2. Networks
3. Systems
4. Applications

PREREQUISITES OS5, HW6, SP5

REQUISITE FOR NW1

SUBJECT NAME **SOCIAL, PROFESSIONAL AND ETHICAL ISSUES**

KNOWLEDGE UNIT TAG AND NAME **SP1: STANDARDS**

DESCRIPTION Discussion of the responsibilities of the individual in the computing industry for setting professional standards and ethics.

TOPICS Minimum number of hours: 2

1. Standards of professional societies
2. Codes of ethics

PREREQUISITES None

REQUISITE FOR SP2

SUBJECT NAME **SOCIAL, PROFESSIONAL AND ETHICAL ISSUES**

KNOWLEDGE UNIT TAG AND NAME **SP2: RESPONSIBILITIES TO SOCIETY**

DESCRIPTION Discussion of the interaction between the computing professional and society responsibilities

TOPICS Minimum number of hours: 2

1. Responsibilities to client or employer
2. Responsibilities to the profession
3. Responsibilities to oneself
4. Conflicts resolution
5. The need for accepted standards for professional behavior and ethical standards

PREREQUISITES SP1

REQUISITE FOR SP3

SUBJECT NAME **SOCIAL, PROFESSIONAL AND ETHICAL ISSUES**

KNOWLEDGE UNIT TAG AND NAME **SP3: PROFESSIONAL ETHICS**

DESCRIPTION Discussion of the standards, laws, ethics and codes dealing with the computing professional.

TOPICS Minimum number of hours: 2

1. Canons of ethics established by professional societies
2. Application of the canons in case studies
3. Responsibility of the individual to apply ethical standards

PREREQUISITES SP3, SP5

REQUISITE FOR SP4

SUBJECT NAME **SOCIAL, PROFESSIONAL AND ETHICAL ISSUES**

KNOWLEDGE UNIT TAG AND NAME **SP4: SELF-MANAGED EMPLOYEES**

DESCRIPTION Discussion of skills and abilities to perform as a self-managed employee in a work environment.

TOPICS Minimum number of hours: 3

1. Self management by objectives
2. Planning
3. Gant charts and pert charts for planning
4. Time management
5. Evaluation of progress
6. Reporting progress

PREREQUISITES SP3

REQUISITE FOR None

SUBJECT NAME **SOCIAL, PROFESSIONAL AND ETHICAL ISSUES**

KNOWLEDGE UNIT TAG AND NAME **SP5: INTELLECTUAL PROPERTY**

DESCRIPTION Discussion of legal ownership of proprietary assets produced by the computer professional.

TOPICS Minimum number of hours: 1

1. Public policy
2. Rights of the originator, rights of the public
3. Patent
4. Copyright
5. Licenses

PREREQUISITES SP3

REQUISITE FOR OS7

SUBJECT NAME **SOFTWARE METHODOLOGY**

KNOWLEDGE UNIT TAG AND NAME **SM1: FUNDAMENTAL PROBLEM SOLVING CONCEPTS**

DESCRIPTION Introduction to the basic concepts of algorithm development and programming, using the principles of modular top-down design. Basic control structures, data types, and input/output conventions. Included would be a programming language introduction.

TOPICS Minimum number of hours: 16

1. Introduction to algorithmic problem solving
2. Control structures (sequence, selection, iteration)
3. Data types (numeric, alphanumeric)
4. The software design process (specification through implementation and testing)
5. Program implementations

PREREQUISITES Algebra and beginning logic

REQUISITE FOR SM2

SUBJECT NAME **SOFTWARE METHODOLOGY**
KNOWLEDGE UNIT TAG AND NAME **SM2: SOFTWARE DEVELOPMENT PROCESS**

DESCRIPTION Introduction to the development of software. Use of tools in the design and implementation of software systems.

TOPICS Minimum number of hours: 8

1. Modular design and programming; specification and design tools
2. Module implementation, testing, documentation, and maintenance
3. Data normalization
4. Computer-aided software engineering (CASE)
5. Object-oriented programming (OOP)
6. Build vs. buy decisions
7. Security
8. Standards

PREREQUISITES SM1
REQUISITE FOR SM3

SUBJECT NAME **SOFTWARE METHODOLOGY**
KNOWLEDGE UNIT TAG AND NAME **SM3: SOFTWARE REQUIREMENTS AND SPECIFICATIONS**

DESCRIPTION Introduction to the development of specifications for defining software requirements.

TOPICS Minimum number of hours: 6

1. Requirements analysis
2. Informal specifications
3. Formal specifications, documentation
4. Interviewing strategies and skills for information gathering
5. Different system design models
6. Standards

PREREQUISITES SM2
REQUISITE FOR SM4

SUBJECT NAME **SOFTWARE METHODOLOGY**

KNOWLEDGE UNIT TAG AND NAME **SM4: SOFTWARE DESIGN AND IMPLEMENTATION**

DESCRIPTION Introduction to the elements of design and implementation of computer systems. Introduction to the debugging and testing of software systems.

TOPICS Minimum number of hours: 10

1. Process design
2. Implementation strategies (top-down, module testing)
3. Implementation issues (debugging, tracing, testing, test data)

PREREQUISITES SM3

REQUISITE None

SUBJECT NAME **STANDARD APPLICATIONS**

KNOWLEDGE UNIT TAG AND NAME **SA1: TEXT PROCESSORS**

DESCRIPTION A discussion of the evolution of text processors and their concepts with emphasis on the installation and configuration of the package.

TOPICS Minimum number of hours: 9

1. Configuration
2. Editors
3. Word processors
4. Desk top publishers
5. Text and screen modes

PREREQUISITES None
REQUISITE FOR SA2, SA3, SA4, SA5, SA6

SUBJECT NAME **STANDARD APPLICATIONS**

KNOWLEDGE UNIT TAG AND NAME **SA2: NUMERIC PROCESSORS**

DESCRIPTION A discussion of the evolution of numeric processors and their concepts with emphasis on the installation and configuration of the application.

TOPICS Minimum number of hours: 10

1. Spreadsheets
2. Statistical software
3. Configuration

PREREQUISITES SA1

REQUISITE FOR SA4

SUBJECT NAME **STANDARD APPLICATIONS**

KNOWLEDGE UNIT TAG AND NAME **SA3: IMAGE PROCESSORS**

DESCRIPTION A presentation of the evolution of image processors and their concepts with emphasis on the installation and configuration of the package.

TOPICS Minimum number of hours: 7

1. Presentation managers
2. Icon builders
3. Scanner/digitizer software
4. Video software
5. Graphics products
6. Configuration

PREREQUISITES SA1

REQUISITE FOR None

SUBJECT NAME **STANDARD APPLICATIONS**

KNOWLEDGE UNIT TAG AND NAME **SA4: DATA ORGANIZERS**

DESCRIPTION A presentation of the evolution of data organizers and their concepts with emphasis on the installation and configuration of the package.

TOPICS Minimum number of hours: 15

1. File managers
2. Data base management systems
3. Report generators
4. Query software
5. Project management software
6. Configuration

PREREQUISITES SA1, SA2

REQUISITE FOR None

SUBJECT NAME **STANDARD APPLICATIONS**

KNOWLEDGE UNIT TAG AND NAME **SA5: COMMUNICATION PROCESSORS**

DESCRIPTION A presentation of the evolution of communication processors and their concepts with emphasis on the installation and configuration of the package.

TOPICS Minimum number of hours: 5

1. E-mail and multi-media mail
2. File transmission applications
3. Remote processing
4. Directory services
5. Configuration

PREREQUISITES SA1

REQUISITE FOR None

SUBJECT NAME **STANDARD APPLICATIONS**

KNOWLEDGE UNIT TAG AND NAME **SA6: AUDIO PROCESSORS**

DESCRIPTION A presentation of the evolution of audio processors and their concepts with emphasis on the installation and configuration of the package.

TOPICS Minimum number of hours: 3

1. Voice mail
2. Verbal (audio) input software
3. Voice (audio) output
4. Configuration

PREREQUISITES SA1

REQUISITE FOR None

PART III

CURRICULA IMPLEMENTATION SAMPLES

1.0 CURRICULUM OVERVIEW

There are three distinct tracks in the computer support services curriculum: hardware, applications, and networks. This provides the student with an opportunity to either specialize in an area or build breadth in the subject area. Each track will have common knowledge units, however the expected exit competencies for each of the knowledge units may differ depending on the track pursued by the student. Exit competencies are listed at the end of Part III.

1.1 Overall Design Considerations

The computer support services curriculum will have to be developed to meet institutional requirements and should take advantage of institutional strengths. Section 3 develops example curricula, including a complete course of study.

Some suggestions for steps to start building a curriculum are:

- Identify goals of the program, focusing on student outcomes:
  What should graduates be prepared for?
  Should there be tracks for different students?
  Are there content topics beyond the suggested knowledge units that every student should study?

- Identify strengths of the faculty:
  What instructional experience do faculty members have?
  Where is their strongest technical expertise?
  What are their interests?

- Identify constraints of the local situation:

What is the institutional philosophy?
What resources are available?
What backgrounds do students arrive with?
What is the level of community support?
What is the level of administrative support?

- Establish a plan and schedule for:
  Design
  Implementation
  Evaluation
  Modification
  Transition

- Design and implement the curriculum:
  Include courses that cover the knowledge units
  Include other educational experiences.

1.2 Course Structure

The knowledge units in Part II of this report specify the scope of topics that all students in the computer support services curriculum should study to some degree or depth. The prerequisite and requisite structure suggests that some sequencing is required in the composition of courses out of knowledge units, but the flexibility of the knowledge units will allow many options.

The knowledge units of a given subject area do not have to be grouped together into what is commonly called a *core course*, as long as they are all covered somewhere in the curriculum. Furthermore, some parts may be covered either in a standard class setting or in a laboratory setting. Thus, the knowledge units of the common requirements can be combined in various way to form courses. In creating courses, the following guidelines should be followed:

- Knowledge units should be combined so that the composite subject matter forms a coherent body of topics for the student.

- The combined set of courses that comprise an implementation should have a prerequisite structure that is consistent with the prerequisites of their constituent knowledge units.

- The combined set of courses that comprise the implementation should cover all of the knowledge units that make up the common requirements.

Implementations may, of course, exceed this minimum by assigning additional depth of coverage or topics beyond those that are suggested in the common requirements.

The design of the courses in this report follow the format described below: (See Figure III-1)

Course Title
A clear but brief name of the course with the course code or number.

Number of Semester Hours
The total number of semester credits and hours, format:
Lecture: (number of credits : number of hours)
Laboratory: (number of credits : number of hours)

Prerequisites
Courses that are to be completed prior to the course being described.

Goal or Purpose of the Course
A brief statement, one or two sentences, expressing the content of the course.

Behavioral Objectives for the Students
Abilities expected of students who successfully complete the course. Conventionally, these abilities are enumerated and preceded by the phrase: "Upon completion of the course, the student should be able to..."

Subject Matter
A table with the following columns:
(a) Knowledge unit tag
(b) Emphasis of knowledge manifested by an emphasis on theory, analysis, or design, as described in Section 1.3.
(c) Depth of knowledge expected to be achieved by the knowledge unit within the course. This is indicted by the Depth Indicator, described in Section 1.4, and integer 1 through 5.

Laboratory/Activity Component
Suggestions for the type of experiences should be provided, including descriptions of the experiences.

CSS INTRO Introduction to Computer Support Services Lecture (3:3)
Laboratory (1:3)

Prerequisite:
None

Goal:
An overview of hardware, standard applications, and networking. This course is designed to be the cornerstone of the curriculum.

Objectives:
Upon completion of this course the student should be able to:

- Describe the hardware components of a computer system
- Describe the functions of an operating system and of a network operating system
- Describe the components of a network
- Describe the network protocols for ethernet, token ring, and Arcnet
- Differentiate between different network topologies
- Describe the interdependence of hardware and software
- Differentiate between software application categories, such as word processing, spreadsheets, databases, and communications

Subject Matter:

KU Tag	Portion of Hours	Depth	Emphasis
OS1	1/6	A	2
OS2	3/3	T	2
OS3	3/4	T	2
OS4	2/2	A	2
HW1	3/3	A	3
HW2	3/3	A	3
HW4	1/4	A	3
HW5	1/9	A	3
HW6	1/4	T	1
NW1	3/8	T	1
NW2	3/10	T	1
NW3	3/11	T	1
NW4	3/10	T	1
SA1	2/9	T	2
SA2	2/10	T	2
SA4	2/15	T	2
SA5	3/5	T	2
SP5	1/1	T	2

Laboratory Experience:

- Boot a PC
- Create a directory and subdirectory structure
- Move through the directory path structure
- Enter data into a spreadsheet, word processor, and database
- Observe the use of communications package(s)

Figure III-1 Course Format Example

1.3 Emphasis of Knowledge

The knowledge units used to form courses indicate the emphasis within the course. The knowledge unit may be taught by different methods depending on the course. This *emphasis* is divided into three paradigms: *theory*, *analysis*, and *design*. *Theory* corresponds to the fundamental knowledge base of the particular unit, generally supported by fact or accepted understanding. *Analysis* corresponds to the scientific method used in verifying or testing a theory. *Design* corresponds to building an entity (hardware, software or network) that demonstrates the general theme of the knowledge unit. Therefore, within courses, the knowledge units used to form a course are appended with an *emphasis code* formed by any combination of the letters T, A, or D, representing *theory*, *analysis*, and *design*, respectively.

As an example, two different courses on computer programming may be constructed from the same knowledge units. The first course may have an emphasis on theory or programming methodology; therefore the knowledge units would have a preponderance of *theory* and *analysis*. The second course, emphasizing the design of programs, would have a preponderance of *analysis* and *design*.

1.4 Depth of Knowledge

Each knowledge unit also has a *depth indicator* which shows the depth to which a student is expected to grasp the material. This indicator is identified by an integer 1 through 5 and is interpreted as follows:

1 Awareness as expressed by general knowledge, definition, or recognition.

2 Description as evidence of conceptual understanding.

3 Differentiation as expressed by the ability to compare/contrast or to make connections with related topics.

4 Application in a structured environment where meaningful decisions are possible under imposed constraints.

5 Application in an unstructured environment requiring meaningful

decision making.

The depth of knowledge or understanding as prescribed is considered minimal for each knowledge unit in its course setting.

1.5 Curriculum Components

Programs should be structured to meet both the local and the future needs, as appropriate. Nevertheless, the flexibility of the curriculum should encourage departmental faculty to maintain coherent and consistent quality which help to meet the needs of the local businesses and industries.

The following components should be part of any curriculum:

Curriculum Title and Degree

A brief name for the curriculum which properly depicts the intended purpose of the program. It is important to specify the degree or certificate which will be obtained when the requirements for that program are satisfactorily met.

Purpose

The purpose of the curriculum, followed by the purpose for each option, if any, is to be given with emphasis on the outcomes that are intended for the student.

Curriculum Course Content

The list of courses that are required in the curriculum, including different options where applicable, followed by the list of courses to be chosen from other disciplines.

Subject Matter Content

The list of knowledge units required in each curriculum and for each option in the curriculum, if any. Indication of the required exit competency for each knowledge unit within the curriculum is essential.

Course Sequence

A table or chart giving the anticipated sequence of courses required for the curriculum.

Exit Competencies

Students completing a curriculum are expected to demonstrate certain competencies after completing the curriculum.

1.6 Curriculum Courses

The required courses for the computer support services curriculum are:

CSS INTRO Introduction to Computer Support Services
This course covers the fundamentals of hardware, standard applications and networking.

CSS PROG Programming Concepts for Computer Support Services
This course covers problem solving and the design and implementation of algorithmic solutions.

CSS HW 1 Introduction to Computer Hardware
This course introduces computer hardware, peripherals, system architecture, and networking hardware.

CSS APP 1 Beginning Software Applications
This course introduces common computer application packages.

CSS NET 1 Introduction to Data Communications and Networking
This course covers basic communication components using a hands-on environment.

CSS CAP Capstone or Internship
The capstone program provides a realistic work experience.

The computer support systems curriculum also requires two additional *specialty courses*, which are dependent upon the choice of specialization within the computer support services curriculum. The specialization choices and the corresponding courses which must be completed are:

Applications Specialty:
The graduate will be able to use, install, configure, verify, troubleshoot and develop applications. The required courses for this specialty are:

CSS APP 2 Networking Software Applications
This course develops the understanding of the installation and configuration of software applications.

CSS APP 3 Advanced Networking Software Applications

This course emphasizes network software applications and project management.

Hardware Specialty:

The graduate will be able to install, configure, verify, troubleshoot a computer system, hardware and associated cabling. The graduate will also be able to administer the system at a very basic level. The required courses for this specialty are:

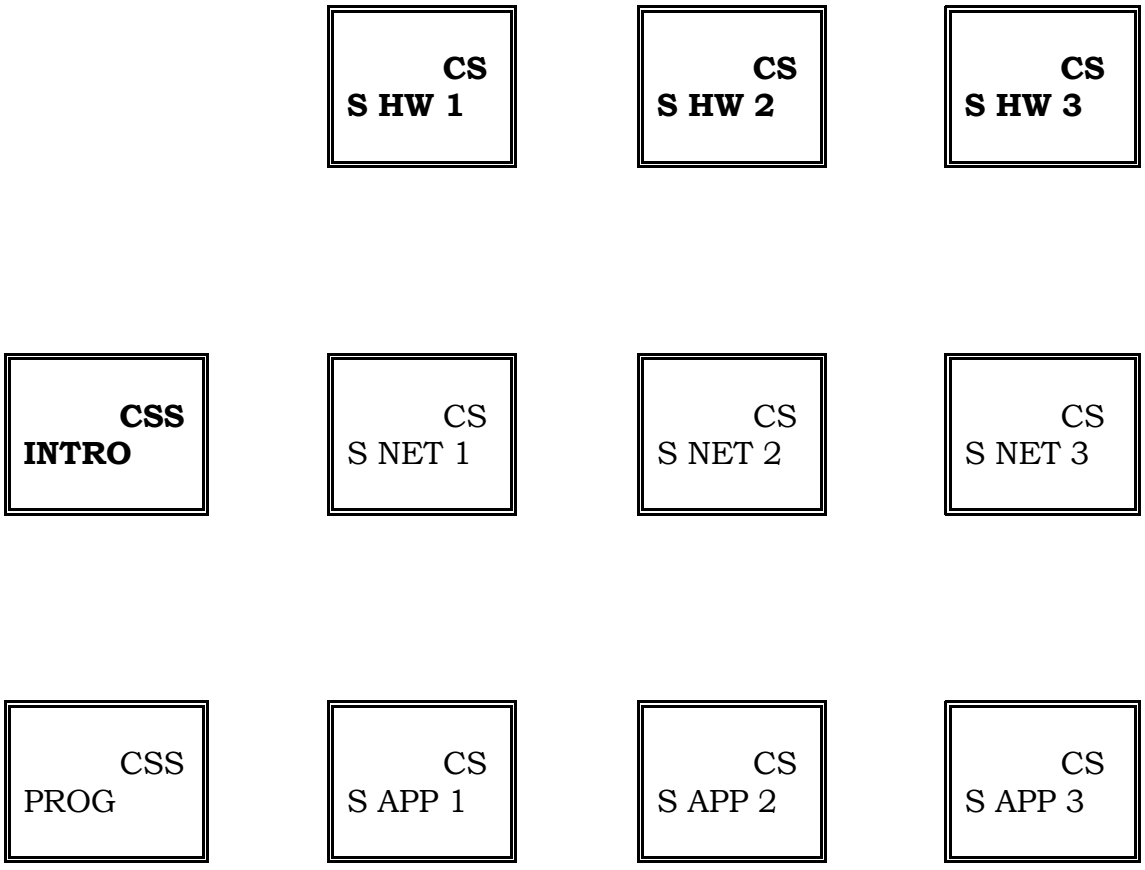

Figure III-2 Course Prerequisite Structure - Except Capstone Course

CSS HW 2 Computer Hardware Components and Interfaces I

This course provides an understanding of computer hardware and their interfaces.

CSS HW 3 Computer Hardware Components and Interfaces II

This course provides a more in-depth study of computer system components.

Networking Specialty:

The graduate will be able to install, configure, verify, and troubleshoot a network system. The required courses for this specialty are:

CSS NET 2 Local Area and Multivendor Networks

This course emphasizes the implementation, configuration, and troubleshooting of a communications system.

CSS NET 3 Managing Networks and Applications

This course covers advanced networking concepts for troubleshooting, installing, and configuring a computer network system.

2.0 UNDERLYING THEMES

Certain fundamental concepts recur throughout the discipline and play an important role in the design of individual courses and the curriculum. These *underlying themes* represent a "glue" that can be used to provide cohesiveness, a view towards how all these elements work together. They represent fundamental abstractions, principles, technical problems, and issues that a student completing this program will encounter in a variety of circumstances.

The computer support services curriculum can convey a wholeness by acknowledging and discussing these underlying themes as they appear during the students' educational experiences. Done properly, the following benefits can occur:

- Minimizing the perception that the curriculum is a fragmented collection of unrelated topics.
- Facilitating learning by the presence of generalizations and analogies.

Below is a list of the underlying themes for the computer support services curriculum:

Binding:

The process of making abstraction more complete by assigning properties to it. Some examples are associating a type with a variable name, associating a process with a processor, and associating a specific task with reference manuals.

Complexity of large problems:

The effects of the nonlinear increase in complexity as the size of a problem grows. This is an important factor in distinguishing and selecting methods to solve an organizational problem/task.

Conceptual models:

Ways of characterizing, visualizing, and thinking about an idea or problem.

Control:

How hardware/software work together to effect a predictable desired result.

Design Concepts:

How things work as a result of design versus how it is installed/configured - or what happens as a result of an update or change.

Effectiveness:

The extent to which a system is complete and correct. That is, the extent to which a system satisfies its specifications.

Efficiency:

A measure of the resources required for the execution of a process, the extent to which a system uses minimal resources.

Evolution:

The changing nature of requirements that causes essentially continuous revision to a software or hardware implementation.

Formal models:

Concepts, notations, and abstractions.

Levels of abstraction:

The ability to represent an entity by abstractions having different levels of detail and specificity. This provides the ability to use a model having only the minimum level of detail needed, thus providing precision and generality.

Management:
The supervision of the system or the software.

Ordering in space:
The relative position of entities in a physical or virtual machine or system. This applies for instance, to communication paths in a local area network.

Ordering in time:
The temporal aspects that surround the execution of a command, as determined by control information and the execution state. Examples are the different types of networking schemes.

Problem Resolution:
The systematic collection of information relating to a problem and the ability to synthesize to form relevant data to solve and verify a problem.

Reliability:
The extent to which systems behave according to specifications under all conditions. This includes responses to error conditions as well as graceful handling of unanticipated situations.

Reuse:
Realizing the potential for components of one system to be used in another system. This applies to using parts from one computer to another, to using one component in a networked system for another system.

Security:
The extent to which hardware and software systems are vulnerable to misuse, as well as effective methods for defending against misuse.

Standards:
Application and implementation of standards, either in hardware or software. An example is the use, installation, and configurations of a modem. It is necessary to understand the standards for the communication in order to configure the hardware and also to configure the software.

Tradeoffs and consequences:
The economic, cultural, and other effects of selecting one design alternative over another. Examples are the consequences of selecting between one software package and another, one hardware system and another, or one network and another.

Underlying themes are independent of any particular discipline and are more fundamental than any occurrence of their use. These ideas, principles, and processes help to unify the program and must be communicated throughout the curriculum so that the student develops an appreciation for how fundamental these concepts are and an ability to apply them in the appropriate contexts.

3.0 SAMPLE CURRICULUM

The sample curriculum in this section is for a two-year career program for an entry level position in business and industry.

Curriculum Title and Degree
Title: Computer Support Services
Degree: Associate

Purpose
This program of study is designed to prepare students for entry-level positions in business, industry, and government.

Curriculum Course Content

Required Computing Courses:
CSS INTRO Introduction to Computer Support Services
CSS HW1 Introduction to Computer Hardware
CSS APP1 Beginning Computing Applications
CSS NET1 Introduction to Data Communications and Networking
CSS PROG Programming Concepts for Computer Support Services
CSS A *(Specialty/Breadth Course 1)*
CSS B *(Specialty/Breadth Course 2)*
CSS CAP Capstone or Internship

The two required *specialty courses*, generically labeled above as CSS A and CSS B, are dependent upon the choice of specialization within the computer support services curriculum. The following are the specialization choices and the corresponding courses which must be completed:

Applications Specialty:
CSS APP 2 Intermediate Computing Applications
CSS APP 3 Advanced Computing Applications

Hardware Specialty:
CSS HW 2 Computer Hardware Components and Interfaces I
CSS HW 3 Computer Hardware Components and Interfaces II

Networking Specialty:

CSS NET 2 Local Area and Multivendor Networks
CSS NET 3 Managing Networks and Applications

After taking a level 2 course in one area, the student may take another level 2 course in a different area, thereby gaining breadth in the field rather than depth in a specialty. Additional computing courses may be offered or required, as needed and could be chosen from other programs such as Computing for Information Processing or Computing and Engineering Technology. Appropriate courses may be chosen as electives.

Other courses:
Students should be required to take two courses in each of the categories of English, business, mathematics, and humanities/social science. The business courses recommended by the committee are: Business Principals and Theory of the Firm (*Business 1*) and Business, Accounting, and Finance (*Business 2*). The students should also be required to complete one course in science and one course in communications. Additional courses may be necessary, depending upon the general education requirements of the local institution.

Subject Matter Content
The following table lists the number of hours each subject area is contained in the common courses for all computer support services students. Additional hours of some of the subject areas will also be covered in the specialty courses.

Subject Name	INTRO	PROG	HW 1	APP 1	NET1
Analysis and Management (AM)		0	0	8	9	4
Hardware (HW)	9	0	24	1	10	
Networks (NW)	12	0	0	0	21	
Operating Systems (OS)	9	0	8	5	3	
Social, Professional and Ethical Issues (SP)		1	3	0	6	0
Software Methodology (SM)		0	37	0	2	0
Standard Applications (SA)		9	0	0	17	2
TOTALS	40	40	40	40	40	

Table III-1 Content Hours of Common Required Courses

Course Sequence

Table III-2 contains a sample four-semester plan of study for the associate degree program in computer support services. Figure III-3 contains a diagram of the design of the three specialty tracks and the courses required for each track.

Semester 1	**Credits**		**Semester 2**	**Credits**
CSS INTRO	4		CSS HW 1	4
CSS PROG	4		CSS APP1	4
Mathematics 1	3-4		CSS NET1	4
English 1	3		Mathematics 2	3-4
Business 1	3		English 2	3
Total Credits	17-18		Total Credits	18-19
Semester 3	**Credits**		**Semester 4**	**Credits**
Communications	3		CSS CAP	3
CSS Specialty 1	4		CSS Specialty 2	4
Social Science 1	3		Social Science 2	3
Business 2	3-4		Science	3-4
Elective 1	3		Elective 2	3
Total Credits	16-17		Total Credits	16-17

Table III-2 Course Scheduling Sequence

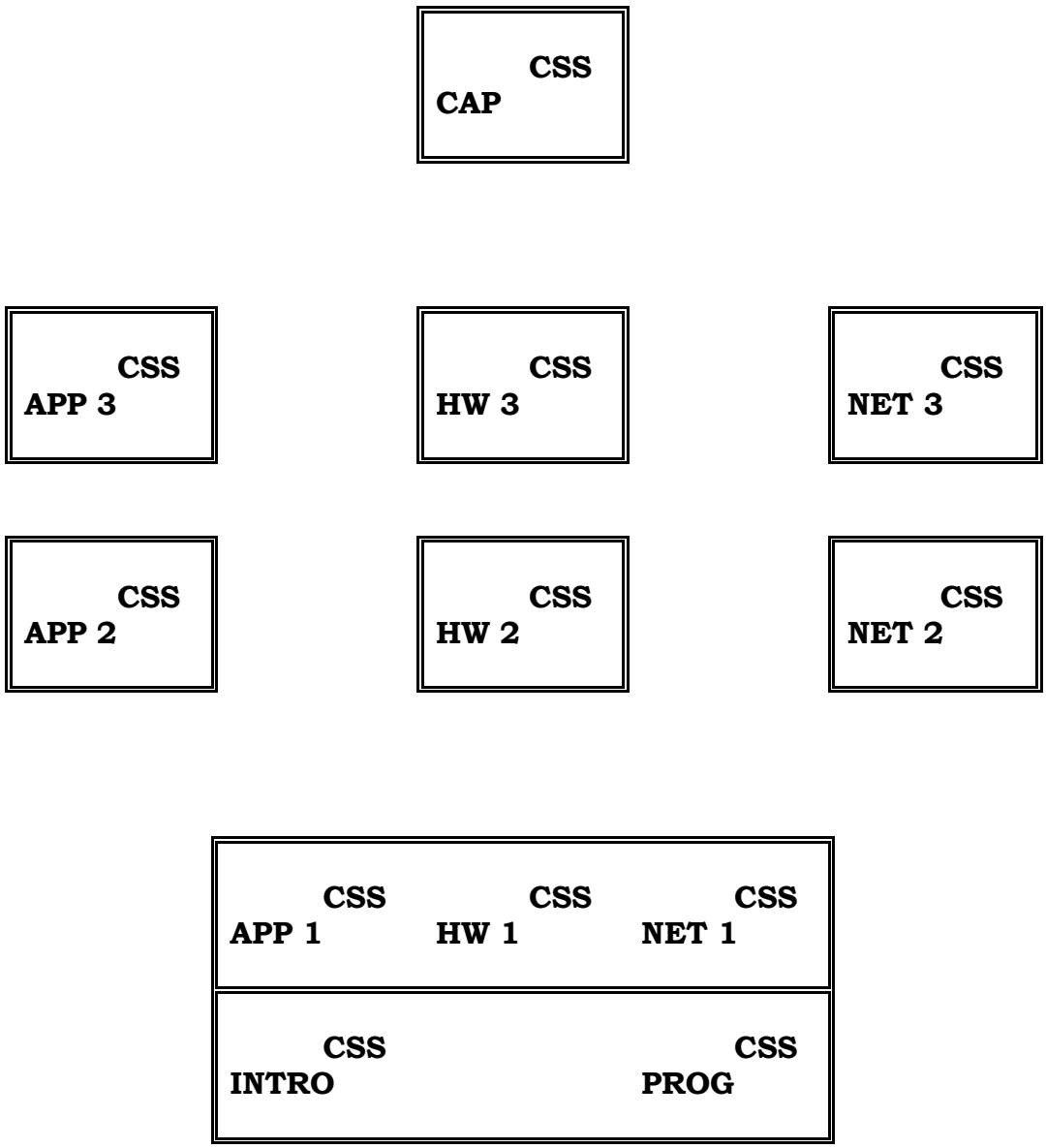

Figure III-3 Suggested Program Design - Three Specialty Tracks

Exit Competencies

A listing of the exit competencies for each of the knowledge units within each of the three tracks is included in Table III-3 at the end of Part III.

4.0 DESCRIPTIONS OF SAMPLE COURSES

The following courses are offered as examples of how a two-year college can apply the knowledge unit concept to create courses for a curriculum. These courses are suggested as a way of structuring the specialization tracks of hardware, software, and networks.

CSS INTRO Introduction to Computer Support Services

CSS PROG Programming Concepts for Computer Support Services

CSS HW 1 Introduction to Computer Hardware
CSS HW 2 Computer Hardware Components and Interfaces I
CSS HW 3 Computer Hardware Components and Interfaces II

CSS APP 1 Beginning Computing Applications
CSS APP 2 Intermediate Computing Applications
CSS APP 3 Advanced Computing Applications

CSS NET 1 Introduction to Data Communications and Networking
CSS NET 2 Local Area and Multivendor Networks
CSS NET 3 Managing Networks and Applications

CSS CAP Capstone or Internship

The descriptions of these courses are listed on the pages that follow.

CSS INTRO Introduction to Computer Support Services Lecture (3:3)
Laboratory (1:3)

Prerequisite:
None

Goal:
An overview of hardware, standard applications, and networking. This course is designed to be the cornerstone of the curriculum.

Objectives:
Upon completion of this course the student should be able to:

- Describe the hardware components of a computer system
- Describe the functions of an operating system and of a network operating system
- Describe the components of a network
- Describe the network protocols for ethernet, token ring, and Arcnet
- Differentiate between different network topologies
- Describe the interdependence of hardware and software
- Differentiate between software application categories, such as word processing, spreadsheets, communications, database

Subject Matter:

KU Tag	Portion of Hours	Emphasis	Depth
OS1	1/6	A	2
OS2	3/3	T	2
OS3	3/4	T	2
OS4	2/2	A	2
HW1	3/3	A	3
HW2	3/3	T	2
HW4	1/4	A	3
HW5	1/9	A	3
HW6	1/4	T	1
NW1	3/8	T	1
NW2	3/10	T	1
NW3	3/11	T	1
NW4	3/10	T	1
SA1	2/9	T	2
SA2	2/10	T	2
SA4	2/15	T	2
SA5	3/5	T	2

SP5	1/1	T	2

Laboratory Experience:

- Boot a PC
- Create a directory and subdirectory structure
- Move through the directory path structure
- Enter data into a spreadsheet, word processor, and database
- Observe the use of communications package(s)

CSS PROG Programming Concepts for Computer Support Services

Lecture (3:3)
Laboratory (1:3)

Prerequisite:
College Algebra

Goal:
The emphasis of this course is on solving problems through the design and implementation of algorithmic solutions involving control structures: sequence, selection, and iteration.

Objectives:
Upon completion of this course the student should be able to:

- Use an editor to enter the steps of an algorithmic solution into a file
- Use the available commands to implement an algorithmic solution
- Create test data for an algorithmic solution and test the reliability of the implementation
- Produce a set of formal specifications for a given problem statement
- Design an algorithmic solution and complete a project with a given a set of formal specifications for a problem requiring incorporation of control structures

Subject Matter:

KU Tag	Portion of Hours	Emphasis		Depth
SM1	13/16	A		4
SM2	8/8	A	4	
SM3	6/6	A	4	
SM4	10/10	A		4
SP2	2/2	A	3	
SP4	2/3	A	3	
SP5	1/1	A	3	

Laboratory Experience:

- Create an algorithmic solution to solve a problem which incorporates sequence, selection, and iteration
- Enter the steps of an algorithmic solution into an appropriate file

- Run the solution and verify the results
- Document the solution
- Incorporate soft and professional skills in presentation and documentation

CSS HW1 Introduction to Computer Hardware Lecture (3:3)
Laboratory (1:3)

Prerequisite:
CSS INTRO Introduction to Computer Support Services

Goal:
Provides an understanding of computer hardware components and their interfaces. The student will discover how the CPU communicates with software and peripherals.This course provides a basic understanding of computer systems.

Objectives:
Upon completion of this course the student should be able to:

- Complete a simple computer installation
- Verify the operation of the installed computer
- Identify an induced fault in a unit or a replaceable component other than chips
- Replace the failed unit or component
- Verify the repaired system

Subject Matter:

KU Tag	Portion of Hours	Emphasis	Depth
OS1	3/6	A	3
OS4	2/3	A	4
OS6	3	T	2
HW3	6	A	4
HW4	6	A	4
HW5	6/9	T	4
HW6	3/4	T	5
HW7	3/3	T	4
AM1	3/5	A	3
AM2	3/6	A	3
AM4	2/4	A	3

Laboratory Experience:

- Install a simple computer (CPU, monitor, keyboard, disk drive, and printer)
- Configure the system
- Verify the system
- Print a copy of the root directory to the printer

CSS HW2 Computer Hardware Components and Interfaces I Lecture (3:3)
Laboratory (1:3)

Prerequisite:
CSS HW1 Introduction to Computer Hardware

Goal:
An introduction to computer hardware, peripherals, system architectures, networking hardware and cabling, boards, and site environmental conditions.

Objective:
Upon completion of this course the student should be able to:

- Explain the function of each system component of the computer
- Understand the relationship of each component to the other
- Identify network hardware components
- Explain the basic function and configuration of network hardware components
- Document a problem and solution

Subject Matter:

KU Tag	Portion of Hours	Emphasis	Depth
OS5	1/4	A	4
OS7	1/4	T	3
HW2	3/3	T	3
HW3	3/4	T	3
HW4	3/4	T	3
HW5	4/9	T	3
HW6	4/4	T	3
SA3	3/7	A	3
SA5	3/5	T	2
SA6	2/3	T	2
NW1	4/8	T	2
NW2	2/10	T	2
NW3	3/11	A	3
NW4	2/10	T	1
NW5	2/5	T	1

Laboratory Experience:

- Identify induced faults in a unit or replaceable unit (except chips)
- Replace the failed unit
- Verify the replacement
- Document the method or process used to determine the fault and the replacement
- Identify network hardware components
- Explain the basic functions and configurations of network hardware components
- Install a network adapter card

CSS HW3 Computer Hardware Components and Interfaces II Lecture (3:3)
Laboratory (1:3)

Prerequisite:
CSS HW2 Computer Hardware Components and Interfaces I

Goal:
Provides a more in depth study of computer system components. This course is intended for the student who plans to specialized in computer hardware. Emphasis is on the solution to complex hardware problems as well as cabling and connectivity problems. The expectation is that the student will be able to solve problems in a more unstructured environment.

Objectives:
Upon completion of this course the student should be able to:

- Identify and fix any hardware fault occurring down to the field replaceable unit
- Identify and fix any cabling or network hardware fault
- Describe chips, boards, and connectivity devices for a new system
- Organize the work effort
- Identify and resolve any hardware problems
- Substantiate the success; verify the computer system
- Document the problem and its solution

Subject Matter:

KU Tag	Portion of Hours	Emphasis	Depth
OS6	8	A	5
HW3	9	A	5
HW5	9/9	A	5
HW7	9	A	5
AM1	3/5	T	2
AM4	2/4	A	2

Laboratory Experience:

- Solve complex realistic repeat customer hardware problems (computer systems, hardware connectivity and network connectivity)

- Document the problem
- Document the stages of the resolution
- Document the processes used to resolve the problem
- Install, verify, and debug a new computer system including a LAN
- Document the system installation
- Print the visual table of contents (VTOC) to verify the computer system
- Send e-mail to verify the local area network
- Teamwork projects should be encouraged

CSS APP1 Beginning Software Applications Lecture (3:3)
Laboratory (1:3)

Prerequisite:
CSS INTRO Introduction to Computer Support Services
CSS PROG Programming Concepts for Computer Support Services

Goal:
The emphasis of this course is the use of software tools and applications.

Objectives:
Upon completion of this course the student should be able to:

- Demonstrate knowledge of the evolution of text processors
- Demonstrate the effective use of a text processor
- Demonstrate knowledge of the evolution of numeric processors
- Demonstrate the effective use of a numeric processor
- Demonstrate knowledge of the evolution of data organizers
- Demonstrate the effective use of a data organizer
- Demonstrate the awareness of the issues involved in planning for systems implementations
- Understand the standards, laws, ethics and codes applicable to the computing professional
- Apply techniques necessary to demonstrate that system problems are logically solvable

Subject Matter:

KU Tag	Portion of Hours	Emphasis	Depth
SM1	2/16	A	2
OS5	2/4	T	3
OS6	1/2	T	2
OS7	2/4	A	3
HW4	1/4	A	3
SA1	4/9	A	3
SA2	4/10	A	3
SA4	8/15	A	3
SA5	1/5	T	2
SP1	1/2	A	3
SP2	1/2	A	3
SP3	1/2	A	3
SP4	2/3	A	3
SP5	1/1	A	3

AM1	2/5	A	3
AM2	2/6	A	3
AM3	2/5	A	3
AM4	3/4	A	3

Laboratory Experience:

- Use a text processors to develop template for system documentation.
- Use a numeric processor to estimate the cost of a simple installation.
- Use a data organizer to set up a simple trouble calls tracking project.
- Extensive use of text and numeric processors, project work utilizing data organizers.

CSS APP2 Networking Software Applications Lecture (1:3)
Laboratory (1:3)

Prerequisite:
CSS APP 1 Beginning Software Applications

Goal:
The emphasis of this course is on further development of the understanding and use of software applications and the introduction of their network relationships.

Objectives:
Upon completion of this course the student should be able to:

- Install and configure a word processing package and a spreadsheet package
- Demonstrate the ability to define software requirements
- Demonstrate the ability to test software applications
- Application of the knowledge necessary to understand and differentiate the issues involved in using network software applications
- Demonstrate the ability to install, configure and use selected communication applications

Subject Matter:

KU Tag	Portion of Hours	Emphasis	Depth
SM3	2/6	D	2
SM4	3/10	D	2
NW3	3/11	T	4
NW4	7/10	A	4
NW5	4/5	T	3
HW5	3/9	T	1
HW7	3/3	T	1
SA5	4/5	D	4
SP3	1/2	T	2
SP5	1/1	T	2
AM5	3/6	T	3
AM6	3/6	T	3
AM7	3/6	T	3

Laboratory Experience:

- Use network software to access information
- Complete a network project to develop access to network applications

CSS APP3 Advanced Network Software Applications Lecture (3:3)
Laboratory (1:3)

Prerequisite:
CSS APP 2 Networking Software Applications

Goal:
The emphasis of this course is on networked software applications: installation, configuration, access and troubleshooting. There also will be an introduction to image and audio processors.

Objectives:
Upon completion of this course the student should be able to:

- Install, configure, setup network access, and troubleshoot software problems
- Demonstrate knowledge of the evolution of image processors
- Demonstrate the effective use of image processors
- Demonstrate knowledge of the evolution of audio processors
- Demonstrate the effective use of an audio processor
- Demonstrate the skills and abilities necessary to perform as a self-managed employee in a work environment
- Demonstrate the ability to clearly identify the purpose of a project
- Demonstrate the ability to plan and organize a project task within resource constraints and designated time frames
- Demonstrate the ability to implement a small scale project to include utilization of appropriate scheduling models

Subject Matter:

KU Tag	Portion of Hours	Emphasis	Depth
HW6	2/4	A	1
SA3	4/7	D	5
SA6	3/3	D	4
SP3	3	A	3
SP4	4	A	4
AM1	3/5	T	3
AM2	3/6	T	3
AM3	2/5	T	3
AM4	3/4	T	3

AM5	4/6	D	2
AM6	4/6	D	4
AM7	4/6	D	5

Laboratory Experience:

- Hands-on imaging/audio environment as appropriate
- Hands-on according to availability of project management software

CSS NET1 Introduction to Data Communications and Networking

Lecture (3:3)
Laboratory (1:3)

Prerequisite:
CSS INTRO Introduction to Computer Support Services

Goal:
This course provides a thorough understanding of how basic network components work and how they work together to form a system using a hands-on environment.

Objectives:
Upon completion of this course the student should be able to:

- Describe the media, signals, functions and steps necessary to achieve reliable transfer of data across point to point data links
- Understand data link protocols
- Describe the principles of operation of terminal networks and protocols
- Describe the differences between circuit switched and packet switched networks
- Understand principles of layering and distinguish between various protocol stacks
- Discuss the concepts of *open systems* and *multivendor networks*
- Understand PC LAN wiring and cabling requirements
- Describe PC LAN components
- Execute some applications such as e-mail and remote login

Subject Matter:

KU Tag	Portion of Hours	Emphasis	Depth
OS1	2/6	T	3
OS6	1/2	T	1
HW3	1/4	A	4
HW4	1/4	T	3
HW5	5/9	D	3
HW7	3/3	T	3
SA5	2/5	A	3
NW1	3/8	T	2
NW2	5/10	D	4
NW3	5/11	D	4
NW4	5/10	A	3
NW5	3/5	T	3
AM2	1/6	T	2
AM5	1/6	T	2
AM6	1/6	T	2
AM7	1/6	T	2

Laboratory Experience:

- Hands-on exercises to demonstrate and reinforce lecture
- Build a synchronous or asynchronous transmission circuit using a modem
- Connect two or more PC's to form a LAN, connect two PC LANs
- Perform file to file copy in a PC LAN
- Implement a print queue in a PC LAN
- Configure a file server in a PC LAN

CSS NET2 Local Area and Multivendor Networks Lecture (3:3)
Laboratory (1:3)

Prerequisite:
CSS NET1 Introduction to Data Communications and Networking

Goal:
The emphasis of this course is on implementation, configuration and troubleshooting of a communications system. The course will expose the student to major LAN protocol suites including defacto standards (TCP/IP), international standards and vendor specific solutions.

Objectives:
Upon completion of this course the student should be able to:

- Describe principal LAN networking standards
- Describe LAN topologies, protocols, transmission media and access methods
- Configure and interconnect a LAN
- Discuss network security mechanisms
- Compare cabling systems
- Apply troubleshooting techniques
- Identify the problems of mixed vendor LAN implementation
- Describe enterprise networking; understand use of routers, bridges, and gateways
- Distinguish between LANs, MANs, and WANs
- Describe internetworking solutions
- Discuss open systems issues and on-going standards work
- Describe functions and services of the upper 3 layers of the OSI Reference Model

Subject Matter:

KU Tag	Portion of Hours	Emphasis	Depth
OS1	1/6	5	5
OS5	3/4	T	3
OS6	2/2	T	2
HW5	6/9	D	4
HW7	4	D	5
NW1	3/8	A	5
NW2	6/10	A	5
NW4	3/10	T	5
NW5	3/5	T	4
AM3	1	A	4
AM4	1	A	4
AM5	2/6	A	2
AM6	2/6	A	2
AM7	2/6	A	2

Laboratory Experience:

- Implement PC to mini or mainframe connection
- Link PC to Mac (or other mixed vendor link)
- Interconnect via a backbone network
- Configure and implement a TCP/IP network using routers (where capability exists)
- Build a small ethernet network or token ring network

CSS NET3 Managing Networks and Applications Lecture (3:3)
Laboratory (1:3)

Prerequisite:
CSS NET 2 Local Area and Multivendor Networks

Goal:
The emphasis of this course is on advanced networking concepts for troubleshooting, installing, and configuring computer network systems. The student will be exposed to the effective use of hardware and software tools for all system parts.

Objectives:
Upon completion of this course the student should be able to:

- Apply troubleshooting techniques to determine source of network problems
- Use troubleshooting tools for HW and SW
- Use protocol analyzers
- Use tools for monitoring and tuning
- Know how to set network operating system parameters for performance
- Install cabling
- Manage auxiliary storage and peripherals
- Manage print servers and print queues
- Install and run applications
- Implement security measures
- Perform backups
- Provide *help-desk* service
- Plan for disaster prevention and recovery

Subject Matter:

KU Tag	Portion of Hours	Emphasis	Depth
OS4	3	T	5
OS5	3	A	5
OS7	3	T	5
NW4	3	A	5
NW5	6	D	5
HW4	3	T	4
HW5	2	A	4
HW6	2	T	5
HW7	3	A	5
SA1	3	A	5
SA2	2	A	5
SA3	1	A	5
SA4	1	A	5
SA5	1	A	5
AM6	2	T	4
AM7	2	T	5

Laboratory Experience:

- Hands-on troubleshooting with software and equipment
- Installation of cabling in the classroom and/or work environment
- Work at the institution's help-desk
- Install applications
- Install and monitor a security system

CSS CAP Capstone/Internship Laboratory (3:20)

Prerequisite:
CSS PROF Professional Development
First Specialty Course (CSS HW2, CSS APP2, or CSS NET2)

Goal:
A Capstone program provides a realistic work experience. This program should be undertaken in the final semester. The program could consist of approximately 180 hours, nominally having twenty hours of experience per week in four hour time blocks.

The host organization should assign a manager to be responsible for oversight of each student. The host organization, the institution, and the student should agree on a check list before hand, so that the student will know what to expect from the program and on what basis the student's work will be evaluated by the host organization and by the responsible faculty.

The content of each student's program should be consistent with the student's specialization. The content of each student's program should allow the student to synthesize the elements of the educational program into a realistic work experience. The student should submit a written report at the end of the program to the host organization and to the responsible faculty member. The report may be a journal or a report on a particular task undertaken by the student during the program. Work performed by the student for the host organization may be compensated.

Objectives:
The scope of the Capstone program should allow for experience in the following areas:

Work Basics

- Practice basic skills in reading, writing, and calculation
- Experience, understand, and adapt to the culture of the host organization
- Follow the rules and regulations of the host organization, including punctuality, civility, responsibility
- Develop communications skills, including writing, listening and speaking with host organization superiors, co-workers, and customers, suppliers, and third parties.

Learning to Learn

- Cope with new learning in the working environment
- Learn to use a new software package (word processor, spreadsheet, database, etc.) without close supervision or coaching
- Learn the customs and culture of the host organization

Communications Skills

- Practice oral communication skills, speaking and listening
- Practice reading and writing skills

Problem Solving

- Participate in work environment problem solving skills
- Apply formal knowledge with creativity to solve problems
- Practice problem solving skills with limited direction and coaching

Professional Development

- Establish goals that will enhance self-confidence and self-esteem
- Establish goals that are consistent with the program objectives and assigned responsibilities
- Provide self-motivation to accomplish stated objectives

Teamwork and Individual Responsibility

- Participate as a member of a work group
- Communicate ideas and objectives to group members
- Volunteer for pieces of project tasks
- Ask questions to gain project understanding
- Report progress on project tasks to group members
- Listen and carefully assess ideas of others
- Complete project tasks on time

Effectiveness and Accountability

- Establish a system which will ensure the integrity and completeness of the project tasks
- Review completed project parts to ensure correctness and if incorrect be willing to admit error and willingly correct the work

The ideal Capstone program will address all of the above elements. While in practice the ideal may be difficult to attain, effort should be applied to providing a program for each student which synthesizes what has been learned in the

class room. The student must be able to adapt to the host organization and function within that organization. The opportunity to develop personal skills which will distinguish the graduate of this program must exist. The well conceived Capstone program, with close cooperation from host organizations, will be a formative as well as a memorable experience for each student.

TAG	NAME	HARDWARE Exit Depth	APPLICATION Exit Depth	NETWORKS Exit Depth
AM1:	Appraising Situations	4	4	4
AM2:	Decision Analysis	4	4	4
AM3:	Potential Problem Analysis	4	4	4
AM4:	Problem Analysis	4	4	4
AM5:	Project Management - Definition	2	2	2
AM6:	Project Management - Planning	4	4	4
AM7:	Project Management - Implementation	5	5	5
HW1:	Standards	2	2	2
HW2:	Architecture & Processors	3	2	2
HW3:	Chips & Boards	5	2	4
HW4:	Peripherals	4	3	4
HW5:	Network Hardware & Cabling	5	1	4
HW6:	Computational Site Environment	5	1	5
HW7:	Connectivity Devices	5	1	5
NW1:	Network Architecture, Topologies & Access	2	3	5
NW2:	Network Transmission & Media	2	3	5
NW3:	Connectivity & Interoperability	3	4	5
NW4:	Network Applications	1	4	5
NW5:	Network Administration	1	3	5
OS1:	Operating Systems	3	5	5
OS2:	Process Management	2	3	3
OS3:	Memory Management	2	4	4
OS4:	Auxiliary Storage Management	5	3	5
OS5:	Security	4	5	5
OS6:	Open Systems	2	2	2
OS7:	System Administration	3	3	5
SP1:	The Role of the Professional in Society	1	1	1
SP2:	Responsibilities to Society	2	2	2
SP3:	Professional Ethics	4	4	4
SP4:	Self-managed Employees	4	4	4
SP5:	Intellectual Property	3	3	3
SM1:	Fundamental Problem Solving Concepts	4	4	4
SM2:	Software Development Process	3	3	3
SM3:	Software Requirements & Specifications	2	4	3
SM4:	Software Design & Implementation	4	4	4
SA1:	Text Processors	4	4	4
SA2:	Numeric Processors	3	5	4
SA3:	Image Processors	3	5	5

SA4: Data Organizers	2	5	5
SA5: Communication Processors	3	4	5
SA6: Audio Processors	3	4	4

Figure III-7 Expected Exit Competencies