This course curriculum is intended for use by community college instructors and administrators in implementing a fundamentals in hardware course. A student's course syllabus provides this information: credit hours, catalog description, prerequisites, required text, instructional process, objectives, student evaluation, and class schedule. A student lecture guide consists of a sheet for each of the 15 units with unit contents, unit objectives, rationale, learning activities, vocabulary, and evaluation. Unit topics are the following: introduction; environmental and operating procedures—reducing potential problems; preparation, documentation, and tools; troubleshooting strategies and skills; troubleshooting; processors; computer architecture and assembly language; disk drives; servicing printers; writing specifications for orders; troubleshooting the main computer and keyboard; modems, monitors, cassette recorders, and game controllers; troubleshooting power supplies; microcomputer installation and upgrading; and future prospects for computer hardware. A student lab guide provides this information for each of the 15 units: objectives, required equipment and materials, learning activities, steps, and evaluation. The instructor's course syllabus outlines prerequisites, required text, references, required equipment and materials, instructional process, and student evaluation. Competency statements and a course outline are included. The instructor's guide presents this information for each unit: contents, objectives, required equipment and materials, procedures, learning activities, and evaluation. (YLB)
Curriculum Improvement Project
Region II
FUNDAMENTALS OF HARDWARE
Developed by Femi Onabajo

Prepared by:
Galveston College

With Support From:
Coordinating Board
Texas College and University System
Division of Community Colleges
and Technical Institutes
PVEP 87-1030-B-2
Project Director: Cheryl L. Willis, Ph.D.

June 30, 1987

BEST COPY AVAILABLE
Galveston College is not unlike other small community colleges trying to keep its curriculum in sight of rapidly changing technologies. We are unique, however, in that we were given an opportunity by the Coordinating Board of the State of Texas through a grant of Carl D. Perkins Act vocational funds to undertake a major curriculum improvement project which had as its focus curricula for accounting, the allied health professions, microcomputer applications, and office occupations. The course curriculum that you have before you is one of nine courses or modules that were developed from this project. What cannot be immediately evident to you, though, is the sense of cooperation that governed the various phases of the project. The resulting benefits to the College, its faculty, and its staff as a result of this project were many, including increased knowledge of the curriculum improvement process, increased knowledge of the ramifications of networking microcomputers, increased awareness of the vocational programs of other community colleges, and increased awareness of the need for staff development opportunities. The enduring impact of this project will come in the months ahead as our instructors, and hopefully other instructors across Region II and the state, implement the curricula. We at Galveston College are proud of the results of the Curriculum Improvement Project and hope that your college will share the benefits.

Dr. Marc A. Niglizzo
Vice President and Dean of Instruction
June 30, 1987
REGION II
CURRICULUM IMPROVEMENT PROJECT
EXTERNAL ADVISORY BOARD

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Fundamentals of Hardware--Femi Onabajo
Galveston College
Galveston, Texas

Copies of the above course curriculum are available for a nominal cost from:
Division of Business and Technology
Galveston College
4015 Avenue Q
Galveston, TX 77550
ACKNOWLEDGMENTS

This course curriculum represents but one of the many final products of the Curriculum Improvement Project. I want to take this opportunity to thank those individuals who worked so hard together to bring this project to a successful conclusion. To the administration and the Board of Regents of Galveston College I wish to express my appreciation for their willingness to accept the challenges and risks associated with a project of this magnitude and for having the forethought to see its benefits for the college and the community. To the support staff in the Business Office and the Office of Planning and Development, thank you for your patience and helpfulness in providing the project staff with everything we needed--yesterday. To Karla Back, Assistant Dean of the Division of Business and Technology, for her constant encouragement of the vision of the project, I will be forever grateful. My most heartfelt thanks, though, go to the project team--all of the curriculum writers who gave 110 percent effort whenever it was needed; the various editors and word processors who helped us along the way; Paul Fama, Research Associate, who provided constancy and consistency; and Mary James, project secretary, who kept us all sane.

Galveston, Texas
June 30, 1987

Cheryl L. Willis, Ph.D.
Project Director
PREFACE

The following course curriculum should be used as a resource by fellow instructors and administrators when making decisions about implementing a similar course at their institutions. This course curriculum contains five parts--student's course syllabus, student's lecture guides and student's laboratory guides for each unit of the course, instructor's course syllabus, and instructor's guides for each unit of the course. The materials presented in this course curriculum are only a suggested format for a course of this nature and, as typical with community college curriculum, will undergo revision in the future. The author and Galveston College welcome your comments regarding your experience with these materials.
STUDENT COURSE SYLLABUS
CST 2403: FUNDAMENTALS OF HARDWARE

STUDENT'S COURSE SYLLABUS

Course Title: Fundamentals of Hardware

Course Number:

| Prefix | CST | No. 2403 | Lecture Hrs. 3 | Lab Hrs. 2 | Credit Hrs. 4 |

Catalog Description:

An introduction to hardware fundamentals. Topics include constructing sample digital circuits, circuit design fundamentals, peripheral linkage design and interfaces; operational characteristics of and implementation factors involving different computers and peripherals (graphic adapter, multifunction cards, auxiliary storage devices, and alternative I/O devices). Optimal combinations of hardware and applications software in problem solving will also be discussed.

Prerequisites:

CSC 1301--Introductory Computing
CSC 1305--Logic and Theory
CSC 1401--BASIC Language

Text:

How to Maintain and Service Your Small Computer, by John G. Stephenson and Bob Cahill, Howard W. Sams & Co., A Division of Macmillan, Inc.

Instructional Process:

1. Student Lecture Guides provide outlines of lecture content, objectives, and requirements for each unit. Students should be encouraged to write definitions for vocabulary words provided in Student Lecture Guides. Student Lab Guides provide outlines of laboratory assignments required and materials needed.
2. There will be several laboratory assignments following the student's laboratory guide.
3. There will be several tests and laboratory assignments.
Objectives:

Upon completion of this course, the student will be able to:

1. Acquire an understanding of the concept of computer hardware.
2. Gain the ability to troubleshoot a microcomputer.
3. Perform maintenance on a microcomputer.
4. Acquire the ability to write a specification for a new system.
5. Learn microcomputer assembly from a kit.

Evaluation of Students:

Examinations: Three exams and a final will be given during the semester. The students will have an option to drop one exam out of the three. NO MAKE-UP WILL BE GIVEN WITHOUT PRIOR APPROVAL.

Laboratory Assignments: There will be fifteen lab assignments, one of which must be completed by all students after each lab section.

Final Grade Determination:

Grades for the semester will be determined based on the accumulated points earned. To determine a tentative grade, divide the total points earned by the possible points. The grading scale will be strictly: 90, 80, 70, 60 ... percent of the possible points.

Approximately 40% of the total points will be from lab assignments, 40% from the exams, and 20% from the final exam.
### Class Schedule:

<table>
<thead>
<tr>
<th>Week No.</th>
<th>Description</th>
<th>Due</th>
<th>Assignment</th>
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<tr>
<td>1</td>
<td>General Introduction and Computer System</td>
<td>Lab 1</td>
<td>Chap. 1, 2, 3</td>
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<td></td>
<td>Today's Equipment - A Service Profile</td>
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<td>Servicing Your Equipment - The Options</td>
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<td>2</td>
<td>The Electronic Environment</td>
<td>Lab 2</td>
<td>Chap. 4</td>
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<td>The Computer Can Affect the Environment</td>
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<td>Preventive Maintenance</td>
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<td>Disk-Handling Procedures</td>
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<td>File Management</td>
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<td>3</td>
<td>General Skills</td>
<td>Lab 3</td>
<td>Chap. 5</td>
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<td>Documentation and Advice</td>
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<td>Test Instruments</td>
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<td>General Principles</td>
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<td>Chap. 6</td>
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<td>Checking Discrete Components</td>
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<td>Integrated Circuits (IC's)</td>
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<td>5</td>
<td>Specific IC Devices</td>
<td>Lab 5</td>
<td>Chap. 7</td>
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<td>The System</td>
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<td>Z80</td>
<td>Lab 6</td>
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<td>Others</td>
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<td>7</td>
<td>General Architecture of a Microcomputer</td>
<td>Lab 7</td>
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<td>Why Assembly Language?</td>
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<td>Assemblers and Loaders</td>
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<td>Debuggers</td>
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<td>Number System</td>
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<td>Instruction Set</td>
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<td>Execution of an Assembly Language</td>
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<td>8</td>
<td>Inside a Disk Drive</td>
<td>Lab 8</td>
<td>Chap. 8</td>
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<td>Service Problems with Diskettes and Disk-Drives</td>
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<td>Maintaining Disk Drives</td>
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<td>Troubleshooting Disk Drives</td>
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<td>Alignment and Adjustments</td>
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<td>Checking Individual Circuits and Mechanisms</td>
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<td>Week No.</td>
<td>Description</td>
<td>Due</td>
<td>Assignment</td>
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</table>
| 9       | Inside a Printer  
Possible Printer Problems  
Periodic Cleaning and Maintenance  
Troubleshooting  
Troubleshooting and Adjusting Specific Subsystems | Lab 9 | Chap. 9 |
| 10      | Different Types of Specifications  
Specification and Verification  
Specification Testing  
Manufacturer's IC Numbering System  
Mail-order Parts Dealers  
Pinouts and Base Diagrams | Lab 10 | Appendices a,b,c,d |
| 11      | Inside a Microcomputer  
Four Common Symptoms  
Checking Key Signals on the CPU | Lab 11 | Chap. 10 |
| 12      | Modems  
Monitors  
Cassette Recorders  
Game Controllers | Lab 12 | Chap. 11 |
| 13      | Power Loss in the Equipment  
Electrical Noise in the Power Supply  
High or Low Voltage from the Supply | Lab 13 | Chap. 12 |
| 14      | Assembly from Kit to System  
System Expansion and Upgrading  
System Performance and Evaluation  
Networking | Lab 14 | ** |
| 15      | Demand versus Price  
A New Technology  
A Workstation Approach  
Communications Hardware  
The Office of Tomorrow | Lab 15 | ** |
| 16      | Final Exam | ** | ** |

Note: ** Check Student Guide for reading assignments and detailed information.
Unit Title: General Introduction

Contents of Unit:
1. General Introduction and Computer System
2. Today's Equipment - A Service Profile

Unit Objectives:
Upon completion of this unit, the student will be able to:
1. Describe different parts of a computer system and their function.
2. Describe the different types of computer system service problems.
3. Describe the relationship between the age of a microcomputer and its service-related problems.
4. Describe the service equipment options.

Rationale:
Students must understand the history and service profile of a microcomputer to fully appreciate a hardware course.

Learning Activities:
Lecture:
Read Chapters 1, 2, and 3

Laboratory:
Complete Student's Lab Guide #1

Terms (Vocabulary):
IC's
diodes
RAM
electromechanical modems
cables
switches

TTL
resistor
DC
discrete
controllers
monitors
connectors

transistor
voltage
AC
MTBF
disk drives
frequency
burn in
CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 2

Unit Title: Environment and Operating Procedures - Reducing Potential Problems

Contents of Unit:

1. The Electronic Environment
2. The Computer Can Affect the Environment
3. Other Environmental Factors
4. Preventive Maintenance
5. Disk-handling Procedures
6. File Management

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the electronic environment.
2. Describe preventive maintenance.
3. Describe disk-handling and file management procedures.

Learning Activities:

Lecture:
Read Chapter 4

Laboratory:
Complete Student's Lab Guide #2

Evaluation:

Lecture:
None

Laboratory:
Lab #2 for grading (Performance)
**Terms (Vocabulary):**

<table>
<thead>
<tr>
<th>Spikes</th>
<th>Transients</th>
<th>Susceptible</th>
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<td>Surge</td>
<td>Motor</td>
<td>Brownout</td>
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<td>Power supplies</td>
<td>Intermittent</td>
<td>Current flow</td>
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<td>FET</td>
<td>CMOS</td>
<td>Conductive</td>
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<td>Static</td>
<td>Softener</td>
<td>Filter</td>
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<td>Varistor</td>
<td>Short-circuits</td>
<td>Coil</td>
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<tr>
<td>MHz</td>
<td>Fuzzy</td>
<td>Coaxial</td>
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<tr>
<td>Insulator</td>
<td>FRD</td>
<td>DOS</td>
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<td>Bugs</td>
<td>Shield</td>
<td>Interference</td>
</tr>
</tbody>
</table>
Unit Title: Preparation, Documentation, and Tools

Contents of Unit:

1. General Skills
2. Documentation and Advice
3. Test Instruments

Unit Objectives:

Upon completion of this course, the student will be able to:

1. Demonstrate good work habits.
2. Perform some safety functions.
3. Demonstrate the ability to use test equipment.
4. Demonstrate the ability to use electronic tools.

Rationale:

Students must fully understand computer hardware and associate electronic tools to be able to avoid accidents.

Learning Activities:

Lecture:
Read Chapter 5

Laboratory:
Lab #3 for grading (Performance)

Terms (Vocabulary):

edge-card connector  screwdrivers  ECO
ground             AC line (hot)   VOM
DVM                 digital logic probe  LED’s
inverter            troubleshoot  pulses
logic pulser         reset            set
AND gate             oscilloscope  coupling
desolder pump        sponge           solder
disk exerciser       wire strippers  tweezers
screwdrivers         nut drivers     transformer
wrenches             logic state analyzer  solenoids
Unit Title: Troubleshooting Strategies and Skills

Contents of Unit:

1. General Principles
2. Checking Discrete Components
3. Electromechanical Parts
4. Integrated Circuits (IC’s)

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the strategic order in making repair as quickly as possible.
2. Describe good test points.
3. Stimulate circuits for tests.
4. Describe and troubleshoot discrete components of the system.

Rationale:

Troubleshooting is one of the most important aspects of this unit and of the entire course. Students must understand how to troubleshoot a microcomputer before they can fix it.

Learning Activities:

Lecture:
Read Chapter 6

Laboratory:
Lab #4 for grading (Performance)

Terms (Vocabulary):

rectifier subsystem interface
ROM socket fault
electrolytic test pin chassis
logic ground signals stimulating
peek CPU schematic
SPST SPDT DPST
DPDT stepper motor servo motor
Unit Title: Troubleshooting

Contents of Unit:

1. Specific IC devices:
   And gates, Or gates and Inverters
   Tristate buffers
   Nand gates, Nor gates, Flip-flops
   Counters and Dividers
   Comparators, Timers and Multiplexer
   Shift registers
   ROM and RAM
   Voltage regulators

2. The System

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the process of troubleshooting specific IC (integrated circuit) devices.
2. Describe the pin arrangements for ROM, RAM etc.
3. Describe and be able to identify the part of the system that is faulty.
4. Troubleshoot a system.

Learning Activities:

Lecture:
   Read Chapter 7

Laboratory:
   Complete Student's Lab Guide #5.

Evaluation:

Lecture:
   None

Laboratory:
   Lab #5 for grading (Performance)
### Terms (Vocabulary):

<table>
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<tr>
<th>AND gates</th>
<th>OR gates</th>
<th>truth table</th>
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<tr>
<td>tristate</td>
<td>chip</td>
<td>memory trick</td>
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<tr>
<td>buffers</td>
<td>flip-flop</td>
<td>RS flip-flop</td>
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<td>JK flip-flop</td>
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<td>dividers</td>
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<td>parallel-in</td>
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<td>refresh signals</td>
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<td>write protect</td>
<td>index detector</td>
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</table>
CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 6

Unit Title: Processors

Contents of Unit:

1. Z80
2. 68000
3. 8086/8088
4. 80286/80386
5. Others

Unit Objectives:

Upon completion of this unit, student will be able to:

1. Describe generations of processors.
2. Demonstrate a knowledge of the capabilities of each of these processors.

Rationale:

Students must be able to define the differences between each generation of processor before they can make recommendations for hardware and software enhancements.

Learning Activities:

Lecture:
Read Heathkit/Zenith Educational Systems.

Laboratory:
Complete Student's Lab Guide #6

Evaluation:

Lecture:
None

Laboratory:
Lab #6 for grading (Performance)
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<th>MSI</th>
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<th>interfacing</th>
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<tbody>
<tr>
<td>data bugging</td>
<td>sequential logic</td>
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<td>stackable leads</td>
<td>logic system</td>
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interfacing
counters
bits
8-bit
trainer
instruction set
addressing mode
Unit Title: Computer Architecture & Assembly Language

Contents of Unit:
1. General Architecture of a Microcomputer
2. Why Assembly Language?
3. Assemblers & Loaders
4. Number System
5. Instruction Set
6. Execution of an Assembly Language

Unit Objectives:
Upon completion of this unit, the student will be able to:
1. Describe the architecture of a microcomputer and assembly language.
2. Define different loaders and assemblers.
3. Describe the process of running an assembly language program.
4. Describe the relationship between assembly language and the architecture of a computer.
5. Define the instruction-execution cycle.

Rationale:
Students must understand the relationship between microcomputer architecture and the assembly language, in order to be able to program and set specifications for different microcomputers.

Learning Activities:

Lecture:
Read Chapters 1-3 of An Introduction to Assembly Language for the 8086 Family, by Thomas P. Skinner.

Laboratory:
Complete Student’s Lab Guide #7
Evaluation:

Lecture: None

Laboratory: Lab #7 for grading (Performance)

Terms (Vocabulary):

- program counter
- status flag
- buffer
- drivers
- megahertz
- loaders
- macros
- resident
- global
- pseudo-operations
- PCL
- index register
- clock
- bootstrap
- IR
- assemblers
- debuggers
- one-pass assemblers
- symbolic
- label
- PCH
- accumulator
- crystal
- ports
- paging
- mnemonics
- micro
- two-pass assembler
- meta-assembler
- operand
Unit Title: Disk Drives

Contents of Unit:
1. Inside a Disk drive
2. Service Problems with Diskettes and Disk Drives
3. Maintaining Disk Drives
4. Troubleshooting Disk Drives
5. Alignment and Adjustment
6. Checking Individual Circuits and Mechanisms

Unit Objectives:
Upon completion of this unit, the student will be able to:
1. Demonstrate a fundamental knowledge of disk drives.
2. Demonstrate the ability to troubleshoot a disk drive.
3. Describe diskette and disk drive management.

Rationale:
Disk drives are one major component of a microcomputer that needs constant maintenance, and students must understand the fundamental makeup of disk drives before they can fix them.

Learning Activities:
Lecture:
Read Chapter 8

Laboratory:
Complete Student’s Lab Guide #8

Evaluation:
Lecture:
Exam #2 (Essay and Objective)

Laboratory:
Lab #8 for grading (Performance)
Terms (Vocabulary):

head carriage  light source  clamping hub
write-protect switch  head load pad  head load arm
activity indicator  index sector pickup  spindle
drive motor  head carriage rails  innermost track
density  soft sector  hard sector
strobe disk action  spiral cam  motor base
motor shaft  stepper motor  microswitch
drive select  waveform  ejector-solenoid
Unit Title: Servicing Printers

Contents of Unit:

1. Inside a Printer
2. Possible Printer Problems
3. Periodic Cleaning and Maintenance
4. Troubleshooting
5. Troubleshooting and Adjusting Specific Subsystems

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate the ability to troubleshoot a printer.
2. Describe different printer subsystems.
3. Demonstrate a working knowledge of printer maintenance.

Rationale:

Students must know how to operate, maintain, and repair printers; and also to be able to train others to do the same.

Learning Activities:

Lecture:
Read Chapter 9

Laboratory:
Complete Student's Lab Guide #9

Evaluation:

Lecture:
None

Laboratory:
Lab #9 for grading (Performance)
Terms (Vocabulary):

clock
control indicators
drive gear
frame
bail rollers
carriage
square drive shaft
infrared light source
reset
print wires
platen
armature
daisy-wheel
cable
support rails
rotating cams
control panel
trimble
return spring
platen
print wheel
idler gear
sensors
felt wick
CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 10

Unit Title: Writing Specifications for Orders

Contents of Unit:

1. Different Types of Specifications
2. Specifications and Verifications
3. Specification Testing
4. Manufacturer's IC Numbering System
5. Mail-order Parts Dealers
6. Pinouts and Base Diagrams

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate the ability to write a proposal for acquiring a new system.
2. Demonstrate the ability to verify and test a system upon delivery.

Rationale:

A critical attribute of any hardware course is for the student to be able to plan and write a specification for a new or used microcomputer system which meets the user's needs.

Learning Activities:

Lecture:
Read Appendices A, B, C, and D

Laboratory:
Complete Student's Lab Guide #10

Evaluation:

Lecture:
None

Laboratory:
Lab #10 for grading (Performance)
Terms (Vocabulary):

- resistor color code
- plastic dip
- high frequency
- low frequency
- channel fet
- semiconductor
- national
- Motorola
- Harris
- monolithic memory
- timers
- PNP
- gate thyristor
- intersil
- Texas Instruments
- pinouts
Unit Title: Troubleshooting the Main Computer and Keyboard

Contents of Unit:
1. Inside a Microcomputer
2. Four Common Symptoms
3. Checking Key Signals on the CPU
4. Troubleshooting the Keyboard

Unit Objectives:
Upon completion of this unit, the student will be able to:
1. Demonstrate the ability to troubleshoot the main computer and keyboard.
2. Define key signals from the CPU.
3. Define the common symptoms surrounding microcomputer problems.

Rationale:
Before a microcomputer malfunction can be traced, students must be able to recognize any problems within the controller or main memory of the system.

Learning Activities:
Lecture:
Read Chapter 10

Laboratory:
Complete Student’s Lab Guide #11

Evaluation:
Lecture:
None

Laboratory:
Lab #11 for grading (Performance)
Terms (Vocabulary):

I/O  power supply  ROM
RAM  disk drive controller  keyboard
video interface  monitor  video RAM
video driver  keyboard decoder  CPU
modem  printer  data bug
clock  reset  data
crystal  oscillator  buffer	network  data strobe  circuits
Unit Title: Modems, Monitors, Cassette Recorders and Game Controllers

Contents of Unit:

1. Modems
2. Monitors
3. Cassette Recorders
4. Game Controllers

Unit Objectives:

Upon completion of this unit, students will be able to:

1. Demonstrate a working knowledge of modem, monitor, cassette recorder, and game controller management.
2. Demonstrate the ability to troubleshoot modems, monitors, cassette recorders and game controllers.

Rationale:

Students must fully understand the fundamental principles of modems, monitors, cassette recorders, and game controllers before they can communicate with another microcomputer or device.

Learning Activities:

Lecture:
Exam #3 (Essay & Objective)

Laboratory:
Lab #12 for grading (Performance)

Terms (Vocabulary):

| RS-232     | stop bits    | baud rate   |
| modem      | terminal     | logic ground|
| significant bit | intermittent problem | monitor |
| crystal     | scanning     | electron gun |
| electron beam | phosphorus screen | capstan |
| flywheel    | supply spindle | joystick |
Unit Title: Troubleshooting Power Supplies

Contents of Unit:

1. Power Loss in the Equipment
2. Electrical Noise in the Power Supply
3. High or Low Voltage from the Power Supply

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate a working knowledge of power supplies.
2. Demonstrate the ability to troubleshoot a power supply.
3. Demonstrate the ability to fine tune a power supply.

Rationale:

Students must be able to regulate the power source to a microcomputer. If there are irregularities in the power supply, the microcomputer will not work.

Learning Activities:

Lecture:
Read Chapter 12

Laboratory:
Complete Student’s Lab Guide #13

Evaluation:

Lecture:
None

Laboratory:
Lab #13 for grading (Performance)

Terms (Vocabulary):

transformer  voltage  filter
capacitor    rectifier  noise
signal       rectifier  ripple
RAM’s        IC’s      heat sink
ttl           slave     growing down
oscillator   SCR       battery
Unit Title: Microcomputer Installation and Upgrading

Contents of Unit:
1. Assembly From Kit to System
2. System Expansion and Upgrading
3. System Performance and Evaluation
4. Networking

Unit Objectives:
Upon the completion of this unit, the student will be able to:
1. Demonstrate the ability to assemble a microcomputer.
2. Describe system expansion and upgrading.
3. Demonstrate the ability to analyze and evaluate system performance.

Rationale:
One of the most important aspects of this course is for students to be able to assemble a microcomputer from a kit to a full system so they will be able to install them on the job.

Learning Activities:
Lecture:
Read Computer Shopper magazine

Laboratory:
Complete Student’s Lab Guide #14

Evaluation:
Lecture:
None

Laboratory:
Lab #14 for grading (Performance)
Terms (Vocabulary):

(Same as previous units)
Unit Title:
Future Prospects for Computer Hardware

Contents of Unit:
1. Demand versus Price
2. A New Technology
3. A Workstation Approach
4. Communications Hardware
5. The Office of Tomorrow

Unit Objectives:
Upon completion of this unit, the student will be able to:

1. Describe the microcomputer’s past and present, and explain the future of computer hardware.

Rationale:
Students must have an idea of where hardware technology is going in order to make reasonable management decisions.

Learning Activities:
Lecture:
Read Computer Shopper magazine

Laboratory:
Complete Student’s Lab Guide #15

Evaluation:
Lecture:
Preparation for final exam

Laboratory:
Lab #15 for grading (Performance)

Terms (Vocabulary):
(All units combined)
STUDENT LAB GUIDE
Unit Title: General Introduction

Time Required:
2 hours

Contents of Unit:
1. General Introduction and Computer System
2. Today's Equipment - A Service Profile

Unit Objectives:
Upon completion of this unit, the student will be able to:
1. Describe different parts of a computer system and their function.
2. Describe the breakdown of computer system service problems.
3. Describe the relationship between the age of a microcomputer and its service-related problems.
4. Describe the service equipment options.

Equipment and Materials Required:
Tool box
Workspace
Lockers

Learning Activities:
Complete Student's Lab Guide #1
Steps:

1. Tour of computer hardware facilities.
2. Check out individual tool boxes.
3. Take inventory of all tools and sign checkout forms.
4. Arrange your tools and become familiar with their names.
5. Lock up your tool box when you finish.

EVALUATION:

Lab #1 for grading (Performance)
Unit Title: Environment and Operating Procedures - Reducing Potential Problems

Time Required: 2 hours

Contents of Unit:

1. The Electronic Environment
2. The Computer Can Affect the Environment
3. Other Environmental Factors
4. Preventive Maintenance
5. Disk-handling Procedures
6. File Management

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the electronic environment.
2. Describe preventive maintenance.
3. Describe disk-handling and file management procedures.

Equipment and Materials Required:

Tool box
Coaxial cable
Diskettes
Twin lead
Varistor
AC line & cable

Learning Activities:

Complete Student's Lab Guide #2
Steps:

1. Take out your tool box and arrange tools on your workspace.
2. Check to see whether you need a surge protector for fluctuations in voltage. If so, install one in your workspace.
3. Check to see if you have a static problem. If so, get an anti-static rug to cover your workspace.
4. Check to see if you have a high voltage problem. If so, install a varistor.
5. Check for a significant amount of interference, smoke, and/or chemicals around the workspace, and check the cooling system. If there are problems in any of these areas, take proper action to rectify them.
6. Do 4.5 & 4.6 on pages 28-29 in the textbook.

Evaluation:

Lab #2 for grading (Performance)
CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 3

Unit Title: Preparation, Documentation, and Tools

Time Required: 2 hours

Contents of Unit:

1. General Skills  
2. Documentation and Advice  
3. Test Instruments

Unit Objectives:

Upon completion of this course, the student will be able to:

1. Demonstrate good work habits.
2. Perform some safety functions.
3. Demonstrate the ability to use some test equipment.
4. Demonstrate the ability to use some electronic tools.

Equipment and Materials Required:

Nut drivers  
Screwdrivers  
Scissors & pliers  
Strippers  
Resistor tester  
Oscilloscope  
Logic probe  
Digital logic probe  
Digital volt-ohm-milliammeter  
Volt-ohm-milliammeter

Learning Activities:

Complete Student's Lab Guide #3
Steps:

1. Get your volt-ohm-milliammeter and check for continuity.
2. If the inside of your computer is accessible, do the following to familiarize yourself with the logic probe: Refer to the documentation for the equipment and find two source points for +5-V DC and ground.
3. Check the signals around the CPU. The test should reveal the following:
   (a) The clock should show a constant string of pulses.
   (b) Each of the addresses and data lines should show constant activity.
   (c) The reset line should pulse whenever you hit the reset button, or boot the computer.
4. Do exercise 5.3.3 for test on your logic pulser.
5. Go through 5.3.4 to get familiar with the oscilloscope.
6. If you have more time, run a test for transistor steps on 5.3.7.
7. Follow 5.3.8 on using your soldering iron.

Evaluation:

Lab #3 for grading (Performance)
Unit Title: Troubleshooting Strategies and Skills

Time Required:
2 hours

Contents of Unit:
1. General Principles
2. Checking Discrete Components
3. Electromechanical parts
4. Integrated Circuits (IC's)

Unit Objectives:
Upon completion of this unit, the student will be able to:
1. Describe the electronic environment.
2. Demonstrate the knowledge of preventive maintenance.
3. Demonstrate the knowledge of disk-handling and file management procedures.

Equipment and Materials Required:
- Capacitors
- Resistors
- Fuses
- A microcomputer
- All materials from Unit #3

Learning Activities:
Complete Student's Lab Guide #4

Steps:
1. Locate a circuit on a schematic and find the actual circuit on the board. For example, locate:
   - ROM IC's
   - CPU
   - Transistor
   - Capacitor
2. Since circuit boards are subject to cracks, examine one visually for such cracks.

3. Test a resistor following the guidelines on 6.2.3 on page 66.

4. Test a diode, following the guidelines on 6.2.4 page 66.

5. Test a capacitor, following the guidelines on 6.2.7 page 67.

6. If you have more time, do the following for testing:
   (a) Fuses - follow 6.2.8
   (b) Transformer - follow 6.2.9
   (c) Transistors - follow 6.2.11
   (d) Switches - follow 6.3.1
   (e) Solenoids - follow 6.3.3
   (f) Stepper Motor/Servo Motor - follow 6.3.5

7. If you like to identify IC's - follow 6.4.1.

Evaluation:

Lab #4 for grading (Performance)
Unit Title: Troubleshooting

Time Required:

2 hours

Contents of Unit:

1. Specific IC devices:
   - And gates, Or gates and Inverters
   - Tristate buffers
   - Nand gates, Nor gates, Flip-flops
   - Counters and Dividers
   - Comparatory, Timers and Multiplexer
   - Shift registers
   - ROM and RAM
   - Voltage regulators

2. The System

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the process of troubleshooting specific IC (integrated circuit) devices.
2. Describe the pin arrangements for ROM, RAM etc.
3. Describe and be able to identify the part of the system that is faulty.
4. Troubleshoot a system.

Equipment and Materials Required:

All materials from Units #3 and #4
Hardware diagnostic diskette

Learning Activities:

Complete Student’s Lab Guide #5
Steps:

1. Use diagnostic software to test the ROM.
2. Check the signals around the RAM to know when to read and when to write.
3. Check the voltage regulator integrated in the power supply - follow 7.1.14.

Evaluation:

Lab #5 for grading (Performance)
Unit Title: Processors

Time Required:

2 hours

Contents of Unit:

1. Z80
2. 68000
3. 8086/8088
4. 80286/80386
5. Others

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe different generations of processors.
2. Describe the capabilities of each of these processors.

Equipment and Materials Required:

Different processor chips
All of Units #3 and #4
Tool box

Learning Activities:

Complete Student’s Lab Guide #6

Steps:

1. Identify the kind of processor on the motherboard.
2. What kind of processor can replace it?
3. Using the soldering iron, take out the processor, count the number of pins, and identify each of them.
4. Put the processor back in the socket and test whether it is working or not.

Evaluation:

Lab # 6 for grading (Performances)
Unit Title: Computer Architecture & Assembly Language

Time Required:
2 hours

Contents of Unit:
1. General Architecture of Microcomputer
2. Why Assembly Language?
3. Assemblers & Loaders
4. Number System
5. Instruction Set
6. Execution of an Assembly Language

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the architecture of a microcomputer and assembly language.
2. Define different loaders and assemblers.
3. Describe the process of running an assembly language program.
4. Describe the relationship between assembly language and the architecture of a computer.
5. Define the instruction-execution cycle.

Equipment and Materials Required:

Tool box
ASM Assembler diskette
All materials from Units #3 & #4

Learning Activities:

Complete Student’s Lab Guide #7
Steps:

1. Trace down the instruction-execution cycle on the motherboard.
2. Go through the process of assembling and debugging an assembly language using a sample program.
3. Execute this program and record your results.
4. Modify the program and go through steps 2 and 3 again.

Evaluation:

Lab #7 for grading (Performance)
Unit Title: Disk Drives

Time Required: 2 hours

Contents of Unit:
1. Inside a Disk Drive
2. Service Problems with Diskettes and Disk Drives
3. Maintaining Disk Drives
4. Troubleshooting Disk Drives
5. Alignment and Adjustment
6. Checking Individual Circuits and Mechanisms

Unit Objectives:
Upon completion of this unit, the student will be able to:
1. Demonstrate a fundamental knowledge of disk drives.
2. Demonstrate the ability to troubleshoot a disk drive.
3. Describe diskette and disk drive management.

Equipment and Materials Required:
Tool box
Diskettes
Disk drives

Learning Activities:
Complete Student's Lab Guide #8

Steps:
1. Perform preventive maintenance on the disk drives:
   (a) Clean the heads - follow 8.3.1
   (b) Lubricate - follow 8.3.4
2. Go through the problem and solution on page 104 - 121, i.e 8.4.1 to 8.6.15.

Evaluation:
Lab #8 for grading (Performance)
Unit Title: Servicing Printers

Time Required: 2 hours

Contents of Unit:
1. Inside a Printer
2. Possible Printer Problems
3. Periodic Cleaning and Maintenance
4. Troubleshooting
5. Troubleshooting and Adjusting Specific Subsystems

Unit Objectives:
Upon completion of this unit, the student will be able to:
1. Demonstrate the ability to troubleshoot a printer.
2. Describe different printer subsystems.
3. Demonstrate a working knowledge of printer maintenance.

Equipment and Materials Required:
Tool box
Printers

Learning Activities:
Complete Student’s Lab Guide #9
Steps:

1. Go through the following list of common symptoms and causes:
   (a) Intermittent problems: Go through 9.4.1.
   (b) Printer starts printing then stops prematurely: go to 9.4.2.
   (c) Printer is completely dead: go to 9.4.3.
   (d) No print action, yet front panel indicator is on: go to 9.4.4.
   (e) Carriage does not move: go to 9.4.5.
   (d) Carriage moves but does not print: go to 9.4.6.
   (e) Printing action, but no characters printing: go to 9.4.7.
   (f) Printer operates slowly: go to 7.4.8.

2. If you have more time, go through pages 134-136.

Evaluation:

Lab #9 for grading (Performance)
Unit Title: Writing Specifications for Orders

Time Required:
2 hours

Contents of Unit:
1. Different Types of Specifications
2. Specifications and Verifications
3. Specification Testing
4. Manufacturer's IC Numbering System
5. Mail-order Parts Dealers
6. Pinouts and Base Diagrams

Unit Objectives:
Upon completion of this unit, the student will be able to:
1. Demonstrate the ability to write a proposal for acquiring a new system.
2. Demonstrate the ability to verify and test a system upon delivery.

Equipment and Materials Required:
Tool box
Specification sheets

Learning Activities:
Complete Student's Lab Guide #10
Steps:

1. You have just been hired as a hardware specialist in a small company. Write a specification to meet the following user’s request:
   * A microcomputer with 640K memory.
   * Must have sufficient memory for storing large amounts of data.
   * Must have a mechanism for backup of the storage media.
   * Needs a printer, and a color monitor.
   * Needs a math co-processor for their applications

2. Write out the specification and the estimated cost.
3. Verify the parts on delivery.
4. Test each part for performance.

Evaluation:

Lab #10 for grading (Performance)
Unit Title: Troubleshooting the Main Computer and Keyboard

Time Required: 2 hours

Contents of Unit:
1. Inside a Microcomputer
2. Four Common Symptoms
3. Checking Key Signals on the CPU
4. Troubleshooting the Keyboard

Unit Objectives:
Upon completion of this unit, the student will be able to:
1. Demonstrate the ability to troubleshoot the main computer and the keyboard.
2. Define key signals from the CPU.
3. Define the common symptoms surrounding microcomputer problems.

Equipment and Materials Required:
- Microcomputer
- Tool box
- Keyboard
Learning Activities:

Complete Student's Lab Guide #11

Steps:

1. Go to the following symptoms and possible solutions:
   (a) Computer starts operating then stops:
       - follow 10.2.1
   (b) Computer makes random errors:
       - follow 10.2.2
   (c) At power on, garbage on screen:
       - follow 10.2.3
   (d) Computer seems dead at power on; no response to commands:
       - follow 10.2.4
   (e) Checking the clock signal:
       - follow 10.3.1

2. To troubleshoot keyboard: - follow 10.4 on page 155

Evaluation:

Lab #11 for grading (Performance)
Unit Title: Modems, Monitors, Cassette Recorders and Game Controllers

Time Required: 2 hours

Contents of Unit:
1. Modems
2. Monitors
3. Cassette Recorders
4. Game Controllers

Unit Objectives:
Upon completion of this unit, the student will be able to:

1. Demonstrate a working knowledge of modem, monitor, cassette recorder, and game controller management.
2. Demonstrate the ability to troubleshoot modems, monitors, cassette recorders and game controllers.

Equipment and Materials Required:
Modems
Monitor
Tool box
Controllers
Microcomputer

Learning Activities:
Complete Student's Lab Guide #12
Steps:

1. Modems:
   (a) Run the modem self-test
   (b) For intermittent problems:
       - follow 11.1.2
   (c) For no ready indicator problems:
       - follow 11.1.3

2. Monitor:
   (a) Troubleshooting monitors:
       - follow 11.2.1

3. Cassette Recorders:
   (b) Troubleshooting Cassette Recorders:
      (i) Intermittent problem, bad output:
          - follow 11.3.1
      (ii) Tape transport problems:
          - follow 11.3.2
      (iii) No output at all:
          - follow 11.3.3

4. Game Controllers:
   (a) Troubleshooting:
       - follow 11.4

Evaluation:

Lab #12 for grading (Performance)
Unit Title: Troubleshooting Power Supplies

Time Required:
2 hours

Contents of Unit:
1. Power Loss in the Equipment
2. Electrical Noise in the Power Supply
3. High or Low Voltage from the Supply

Unit Objectives:
Upon completion of this unit, the student will be able to:
1. Demonstrate a working knowledge of power supplies.
2. Demonstrate the ability to troubleshoot a power supply.
3. Demonstrate the ability to fine tune a power supply.

Equipment and Materials Required:
Power supply
Tool box
Microcomputer

Learning Activities:
Complete Student’s Lab Guide #13

Steps:
1. Troubleshooting:
   (a) Power loss in the equipment:
       - follow 12.1
   (b) Electrical noise in the power supply:
       - follow 12.2

Evaluation:
Lab #13 for grading (Performance)
Unit Title: Microcomputer Installation and Upgrading

Time Required: 2 Hours

Contents of Unit:
1. Assembly From Kit to System
2. System Expansion and Upgrading
3. System Performance and Evaluation
4. Networking

Unit Objectives:
Upon completion of this unit, the student will be able to:
1. Demonstrate the ability to assemble a microcomputer.
2. Describe system expansion and upgrading.
3. Demonstrate the ability to analyze and evaluate system performance.

Equipment and Materials Required:
- Video on microcomputer assembly
- Tool box
- Microcomputer kit

Learning Activities:
Complete Student's Lab Guide #14

Steps:
1. Follow the video on installation step-by-step.
2. Repeat until proficient.

Evaluation:
Lab #14 for grading (Performance)
Unit Title: Future Prospects for Computer Hardware

Time Required: 2 hours

Contents of Unit:

1. Demand versus Price
2. A New Technology
3. A Workstation Approach
4. Communications Hardware
5. The Office of Tomorrow

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the microcomputer’s past and present, and explain the future prospects for computer hardware.

Equipment and Materials Required:

Tool box
Microcomputer

Learning Activities:

Complete Student’s Lab Guide #15

Steps:

1. Go on a field trip to an installation with modern computer equipment.
2. Write a one-page paper on the future of computer hardware.

Evaluation:

Lab #15 for grading (Performance)
CST 2403: Fundamentals of Hardware

INSTRUCTOR'S COURSE SYLLABUS

Course Title: Fundamentals of Hardware

Course Number:

<table>
<thead>
<tr>
<th>Prefix</th>
<th>No.</th>
<th>Lecture Hrs.</th>
<th>Lab Hrs.</th>
<th>Credit Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CST</td>
<td>2403</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
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Catalog Description:

An introduction to hardware fundamentals. Topics include constructing sample digital circuits, circuit design fundamentals, peripheral linkage design and interfaces. Also included will be the operational characteristics of and implementation factors involving different computers and peripherals (graphic adapter, multifunction cards), auxiliary storage devices and alternative I/O devices. Optimal combinations of hardware and applications software in problem solving will also be discussed.

Prerequisites:

CSC 1301--Introductory Computing: A study of the basic principles of computing, input/output media, computer software, number systems, flowcharting, and programming. The course also deals with the computer applications in business and industry.

CSC 1305--Logic and Theory: This course covers the classic, symbolic and mathematical elements of logic and their relation to computers and data processing logic and theory. Emphasis is placed on logic development through program flowcharts and structured charts.

CSC 1401--Programming in BASIC Language: An introduction to a digital computer, fundamental concepts, a study of BASIC programming language with applications and problem solving.

Text:

References:


Problem-Solving Hardware and Software, by Heathkit/Zenith, 1983.


Equipment and Materials Required:

Hardware:
- IBM-PC, Apple, or Franklin microcomputer, scope, multimeter, ohmmeter, logic probe, meter probe, resistor, capacitors, diodes, soldering equipment, logic trainer, chips, schematic diagrams, processors, cables, disk drives, monitor, power supply, different cards, processor trainer, co-processor, and hard disk.

Software:
- 8086/8088 Assembler & IBM Diagnostic Disk

Video Tapes:
- Video tapes on assembly of microcomputer
Instructional Process:

1. Student Lecture Guides provide outlines of lecture content, objectives, and requirements for each unit. Students should be encouraged to write definitions for vocabulary words provided in Student Lecture Guides.

2. Student Lab Guides provide outlines of laboratory assignments required and materials needed.

3. There will be several tests and laboratory assignments.

Evaluation of the Students:

Examinations: Three exams and a final will be given during the semester. The students will have an option to drop one exam out of the three. NO MAKE-UP WILL BE GIVEN WITHOUT PRIOR APPROVAL.

Laboratory Assignment: There will be fifteen lab assignments, one of which must be completed by each student after each lab section.

Final Grade Determination:

Grades for the semester will be determined based on the accumulated points earned. To determine a tentative grade, divide the total points earned by the possible points. The grading scale will be strictly: 90, 80, 70, 60 ... percent of the possible points.

Approximately 40% of the total points will be from lab assignments, 40% from the exams, and 20% from the final exam.

Competency Statement:

Microcomputer Applications Program exit competencies upon which this course is based:

Section I: Job Processing

A. Introduction/Overview

1. Demonstrate a general knowledge of computer system analysis and design.
Instructor's Course Syllabus

2. Demonstrate a general knowledge of the internal operations of computers.
3. Demonstrate the ability to write a proposal for a new microcomputer system according to the specifications from the user.
4. Demonstrate the ability to install a new microcomputer system and to check acceptable performance of each component of the microcomputer.
5. Demonstrate the ability to diagnose and fix minor microcomputer problems.

B. Hardware Procedures

1. Demonstrate a knowledge of computer hardware, including input/output devices, memory, and central processing units.
2. Understand hardware capabilities and analyze hardware needs.
3. Demonstrate the ability to operate a microcomputer.
4. Utilize data backup and restore procedures.
5. Demonstrate a knowledge of routine hardware maintenance and safe storage.

Section II: Hardware Operations

A. Data Processing Equipment

1. Understand the major components of a microcomputer system.
2. Demonstrate the proper handling of microcomputer malfunctions.
4. Determine reason for microcomputer malfunctions.
5. Perform power-on and power-off procedures.
6. Load, start, and unload disk drives.
8. Perform minor maintenance on microcomputer.

B. Peripheral Equipment

1. Perform power-up-down procedures for peripheral equipment.
2. Perform routine maintenance on peripheral devices.
3. Operate external random disk (hard disk, video disk, etc.).
4. Operate modem.
C. Emergency Procedures

1. Perform live data protection procedures during emergency conditions (fire, flood, lightning).
2. Perform data procedures during power surge and failure.
3. Perform hardware recovery operations.
4. Perform emergency backups and power downs.

Section III: Supervisory Functions

A. Product Control

1. Review and evaluate system performance and efficiency.
2. Function as part of a team to solve user problems in information processing.
3. Prepare orientation briefings for users.

B. Equipment Operations

1. Assist with selection and purchasing of data processing equipment.
2. Define systems interface or integration requirements.
3. Estimate systems requirements and capabilities.
4. Consult with proper personnel on adequate preparation of microcomputer operating instructions.
5. Schedule and control equipment maintenance (preventive).
6. Write specifications and verifications.

Section IV: Housekeeping Function, Routine

A. Routine Maintenance of Equipment

1. Inspect diskettes and hard disk for damage.
2. Maintain and change printer ribbons.
3. Inspect and clean system hardware.
4. Perform routine maintenance on all peripheral devices or hardware.

Course Outline:

Contents of Unit 1: General Introduction

1. General Introduction and Computer System
2. Today's Equipment - A Service Profile
3. Servicing Your Equipment - The Options
Contents of Unit 2: Environment and Operating Procedures - Reducing Potential Problems

1. The Electronic Environment
2. The Computer Can Affect the Environment
3. Other Environmental Factors
4. Preventive Maintenance
5. Disk-Handling Procedures
6. File Management

Contents of Unit 3: Preparation, Documentation, and Tools

1. General Skills
2. Documentation and Advice
3. Test Instruments

Contents of Unit 4: Troubleshooting Striates and Skills

1. General Principles
2. Checking Discrete Components
3. Electromechanical Parts
4. Integrated Circuits (IC's)

Contents of Unit 5: Troubleshooting

1. Specific IC devices
   (a) And Gates, Or Gates, Inverter
   (b) Tristate buffers
   (c) Nand Gates, Nor gates, Flip-flops
   (d) Counters and Dividers
   (e) Comparators, Timers, Multiplexer
   (f) Shift registers
   (g) ROM & RAM
   (h) Voltage regulators

2. The System

Contents of Unit 6: Processors

1. Z80
2. 68000
3. 8086/8088
4. 80286/80386
5. Others
Contents of Unit 7: Computer Architecture & Assembly Language

1. General Architecture of a Microcomputer
2. Why Assembly Language?
   (a) Higher Level Language versus Assembly Language
3. Assemblers & Loaders
4. Debuggers
5. Number System
6. Instruction Set
7. Execution of an Assembly Language

Contents of Unit 8: Disk Drives

1. Inside a Disk Drive
2. Service Problems with Diskettes and Disk Drives
3. Maintaining Disk Drives
4. Troubleshooting Disk Drives
5. Alignment and Adjustments
6. Checking Individual Circuits and Mechanisms

Contents of Unit 9: Servicing Printers

1. Inside a Printer
2. Possible Printer Problems
3. Periodic Cleaning and Maintenance
4. Troubleshooting
5. Troubleshooting and Adjusting Specific Subsystems

Contents of Unit 10: Writing Specifications for Orders

1. Different Types of Specifications
2. Specification and Verification
3. Specification Testing
4. Manufacturers' IC Numbering System
5. Mail-order Parts Dealers
6. Pinouts and Base Diagrams

Contents of Unit 11: Troubleshooting the Main Computer and Keyboard

1. Inside a Microcomputer
2. Four Common Symptoms
3. Checking Key Signals on the CPU
4. Troubleshooting the Keyboard
Contents of Unit 12: Modems, Monitors, Cassette Recorders, and Game Controllers

1. Modems
2. Monitors
3. Cassette Recorders
4. Game Controllers

Contents of Unit 13: Troubleshooting Power Supplies

1. Power Loss in the Equipment
2. Electrical Noise in the Power Supply
3. High or Low Voltage from the Power Supply

Contents of Unit 14: Microcomputer Assembling and Upgrading

1. Assembly from Kit to System
2. System Expansion & Upgrading
3. System Performance and Evaluation
4. Networking

Contents of Unit 15: Future Prospects for Computer Hardware

1. Demand versus Price
2. A New Technology
3. A Workstation Approach
4. Communications Hardware
5. The Office of Tomorrow
INSTRUCTOR'S GUIDE
Unit Title: General Introduction

Contents of Unit:
1. General Introduction and Computer System
2. Today’s Equipment - a Service Profile

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the different parts of a computer system and the function of each.
2. Describe the different types of computer system service problems.
3. Demonstrate the relationship between the age of a microcomputer and its service-related problems.
4. Describe the service equipment options.

Equipment and Materials Required:

Lecture:
Text and Student’s Lecture Guide #1

Hardware and Materials:
Tool box
Workspace
Lockers

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Tour
Demonstration
Discussion
Learning Activities:

Lecture:
Read Chapters 1, 2, & 3

Laboratory:
Complete Student’s Lab Guide #1

EVALUATION:

Lecture:
None

Laboratory:
Lab #1 for grading (Performance)
Unit Title:

Environment and Operating Procedures - Reducing Potential Problems

1. The Electronic Environment
2. The Computer Can Affect the Environment
3. Other Environmental Factors
4. Preventive Maintenance
5. Disk-Handling Procedures
6. File Management

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the electronic environment.
2. Demonstrate the knowledge of preventive maintenance.
3. Demonstrate the knowledge of disk-handling and file management procedures.

Equipment and Materials Required:

Lecture:
Text and Student’s Lecture Guide #2

Hardware:
Tool box
Coaxial cable
Diskettes
Twin lead
Varistor
AC line & cable

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion
Learning Activities:

Lecture:
Read Chapter 4

Laboratory:
Complete Student’s Lab Guide #2

Evaluation:

Lecture:
None

Laboratory:
Lab #2 for grading (Performance)
CST 2403: Fundamentals of Hardware

INSTRUCTOR'S GUIDE

Unit 3

Unit Title: Preparation, Documentation, and Tools

Contents of Unit:

1. General Skills
2. Documentation and Advice
3. Test Instruments

Unit Objectives:

Upon completion of this course, the student will be able to:

1. Demonstrate good work habits.
2. Perform some safety functions.
3. Demonstrate the ability to use some test equipment.
4. Demonstrate the ability to use some electronic tools.

Equipment and Materials Required:

Lecture:
Text and Student's Lecture Guide #3

Hardware and Materials:
Nut drivers
Screwdrivers
Scissors & pliers
Strippers
Resistor tester
Oscilloscope
Logic probe
Digital logic probe
Digital volt-ohm-milliammeter
Volt-ohm-milliammeter
PROCEDURES:

Lecture:
   Lecture
   Demonstration

Laboratory:
   Demonstration
   Discussion

LEARNING ACTIVITIES:

Lecture:
   Read Chapter 5

Laboratory:
   Complete Student's Lab Guide #3

EVALUATION:

Lecture:
   None

Laboratory:
   Lab #3 for grading (Performance)
Unit Title: Troubleshooting Strategies and Skills

Contents of Unit:

1. General Principles
2. Checking Discrete Components
3. Electromechanical Parts
4. Integrated Circuits (IC’s)

Unit Objectives:

1. Describe the strategic order in making repairs as quickly as possible.
2. Describe good test points.
4. Describe and troubleshoot discrete components of the system.

Equipment and Materials Required:

Lecture:
Text and Student’s Lecture Guide #4

Hardware and Materials:
Capacitors
Resistors
Fuses
Microcomputer
All materials from Unit #3
Diagnostic diskette

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion
Learning Activities:

Lecture:
  Read Chapter 6

Laboratory:
  Complete Student’s Lab Guide #4

Evaluation:

Lecture:
  Exam #1

Laboratory:
  Lab #4 for grading (Performance)
Unit Title: Troubleshooting

Contents of Unit:

1. Specific IC devices:
   - And gates, Or gates and Inverter
   - Tristate Buffers
   - Nand gates, Nor gates, Flip-flops
   - Counters and Dividers
   - Comparatory, Timers and Multiplexer
   - Shift Registers
   - ROM and RAM
   - Voltage Regulators

2. The System

Unit Objectives:

1. Describe the process of troubleshooting specific IC (integrated circuit) devices.
2. Describe the pin arrangement for ROM, RAM, etc.
3. Describe and be able to identify the part of the system that is faulty.
4. Troubleshoot a system.

Equipment and Materials Required:

Lecture:
- Text and Student’s Guide #5

Hardware and Materials:
- All materials from Units #3 and #4

Procedures:

Lecture:
- Lecture
- Demonstration

Laboratory:
- Demonstration
- Discussion
Learning Activities:

Lecture:
Read Chapter 7

Laboratory:
Complete Student's Lab Guide #5

Evaluation:

Lecture:
None

Laboratory:
Lab #5 for grading (Performance)
CST 2403: Fundamentals of Hardware

INSTRUCTOR’S GUIDE

Unit 6

Unit Title: Processors

Contents of Unit:
1. Z80
2. 68000
3. 8086/8088
4. 80286/80386
5. Others

Unit Objectives:
Upon completion of this unit, the student will be able to:
1. Describe the different generations of processors.
2. Describe the capabilities of each of the processors.

Equipment and Materials Required:
Lecture:
Text and Student’s Lecture Guide #6

Hardware and Materials:
Different processor chips
All materials from Units #4 and #5
Tool box

Procedures:
Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion
Learning Activities:

Lecture:
Read Heathkit/Zenith Educational System.

Laboratory:
Complete Student's Lab Guide #6

Evaluation:

Lecture:
None

Laboratory:
Lab #6 for grading (Performance)
CST 2403: Fundamentals of Hardware

INSTRUCTOR’S GUIDE

Unit 7

Unit Title: Computer Architecture & Assembly Language

Contents of Unit:

1. General Architecture of a Microcomputer
2. Why Assembly Language?
3. Assemblers & Loaders
4. Number System
5. Instruction Set
6. Execution of an Assembly Language

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate the knowledge of microcomputer architecture and assembly language.
2. Define different loaders and assemblers.
3. Describe the process of running an assembly language program.
4. Describe the relationship between assembly language and the architecture of a computer.
5. Define the instruction-execution cycle.

Equipment and Materials Required:

Lecture:
Text and Student’s Lecture Guide #7

Hardware and Materials:
Tool box
All materials from Units #3 and #4
ASM Assembler diskette

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion
Learning Activities:

Lecture: Read Chapters 1-3 of An Introduction to Assembly Language for the 8086 Family, by Thomas P. Skinner.

Laboratory: Complete Student's Lab Guide #7

Evaluation:

Lecture: None

Laboratory: Lab #7 for grading (Performance)
Unit Title: Disk Drives

Contents of Unit:

1. Inside a Disk Drive
2. Service Problems with Diskettes and Disk Drives
3. Maintaining Disk Drives
4. Troubleshooting Disk Drives
5. Alignment and Adjustment
6. Checking Individual Circuits and Mechanisms

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate a fundamental knowledge of a disk drive.
2. Demonstrate the ability to troubleshoot a disk drive.
3. Describe diskette and disk drive management.

Equipment and Materials Required:

Lecture:
Text and Student’s Lecture Guide #8

Hardware and Materials:
Tool box
Diskettes
Disk drives

Procedure:

Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion
Learning Activities:

Lecture:
   Read Chapter 8

Laboratory:
   Complete Student’s Lab Guide #8

Evaluation:

Lecture:
   Exam #2 (Essay & Objective)

Laboratory:
   Lab #8 for grading (Performance)
Unit Title: Servicing Printers

Contents of Unit:
1. Inside a Printer
2. Possible Printer Problems
3. Periodic Cleaning and Maintenance
4. Troubleshooting
5. Troubleshooting and Adjusting Specific Subsystems

Unit Objectives:
Upon completion of this unit, the student will be able to:
1. Demonstrate the ability to troubleshoot a printer.
2. Describe different printer subsystems.
3. Demonstrate a knowledge of printer maintenance.

Equipment and Materials Required:
Lecture:
Text and Student's Lecture Guide #9

Hardware and Materials:
Tool box
Printers

Procedures:
Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion
Learning Activities:

Lecture:
Read Chapter 9

Laboratory:
Complete Student's Lab Guide #9

Evaluation:

Lecture:
None

Laboratory:
Lab #9 for grading (Performance)
Unit Title: Writing Specifications for Orders

Contents of Unit:

1. Different Types of Specifications
2. Specifications and Verifications
3. Specification Testing
4. Manufacturer's IC Numbering System
5. Mail-order Parts Dealers
6. Pinouts and Base Diagrams

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate the ability to write a proposal for acquiring a new system.
2. Demonstrate the ability to verify and test a system upon delivery.

Equipment and Materials Required:

Lecture:
Text and Student's Lecture Guide #10

Hardware and Materials:
Tool box
Specification sheets

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion
Learning Activities:

Lecture:
Read Appendices A, B, C, & D

Laboratory:
Complete Student’s Lab Guide #10

Evaluation:

Lecture:
None

Laboratory:
Lab #10 for grading (Performance)
Unit Title: Troubleshooting the Main Computer and Keyboard

Contents of Unit:

1. Inside a Microcomputer
2. Four Common Symptoms
3. Checking Key Signals on the CPU
4. Troubleshooting the Keyboard

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate the ability to troubleshoot the main computer and keyboard.
2. Define key signals from the CPU.
3. Define the common symptoms surrounding microcomputer problems.

Equipment and Materials Required:

Lecture:
Text and Student's Lecture Guide #11

Hardware and Materials:
Microcomputer
Tool box
Keyboard

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion
Learning Activities:

Lecture:
   Read Chapter 10

Laboratory:
   Complete Student's Lab Guide #11

Evaluation:

Lecture:
   None

Laboratory:
   Lab #11 for grading (Performance)
Unit Title: Modems, Monitors, Cassette Recorders and Game Controllers

Contents of Unit:

1. Modems
2. Monitors
3. Cassette Recorders
4. Game Controllers

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate the ability to manage modems, monitors, cassette recorders, and game controllers.
2. Demonstrate the ability to troubleshoot modems, monitors, cassette recorders and game controllers.

Equipment and Materials Required:

Lecture:
Text and Student’s Lecture Guide #12

Hardware and Materials:
- Modems
- Monitors
- Tool box
- Controllers
- Microcomputer

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion
Learning Activities:

Lecture:
   Read Chapter 11

Laboratory:
   Complete Student’s Lab Guide #12

Evaluation:

Lecture:
   Exam #3 (Essay & Objective)

Laboratory:
   Lab #12 for grading (Performance)
Unit Title: Troubleshooting Power Supplies

Contents of Unit:
1. Power Loss in the Equipment
2. Electrical Noise in the Power Supply
3. High or Low Voltage from the Power Supply

Unit Objectives:
Upon completion of this unit, the student will be able to:
1. Demonstrate a working knowledge of power supplies.
2. Demonstrate the ability to troubleshoot a power supply.
3. Demonstrate the ability to fine tune a power supply.

Equipment and Materials Required:
Lecture:
   Text and Student’s Lecture Guide #13

Hardware and Materials:
   Power supply
   Tool box
   Microcomputer

Procedures:
Lecture:
   Lecture
   Demonstration

Laboratory:
   Demonstration
   Discussion
FUNDAMENTALS OF HARDWARE
Instructor's Guide
Unit 13

Learning Activities:

Lecture:
Read Chapter 12

Laboratory:
Complete Student's Lab Guide #13

Evaluation:

Lecture:
None

Laboratory
Lab #13 for grading (Performance)
CST 2403: Fundamentals of Hardware

Instructor's Guide

Unit 14

Unit Title: Microcomputer Installation and Upgrading

Contents of Unit:

1. Assembly From Kit to System
2. System Expansion and Upgrading
3. System Performance and Evaluation
4. Networking

Unit Objectives:

Upon the completion of this unit, the student will be able to:

1. Demonstrate the ability to assemble a microcomputer.
2. Demonstrate a knowledge of system expansion and upgrading.
3. Demonstrate a knowledge of system performance through analysis and evaluation.

Equipment and Materials Required:

Lecture:
Text and Student's Lecture Guide #14

Hardware and Materials:
Video on microcomputer assembly
Tool box
Microcomputer kit

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion
Learning Activities:

Lecture:
Read Computer Shopper magazine

Laboratory:
Complete Student's Lab Guide #14

Evaluation:

Lecture:
None

Laboratory:
Lab #14 for grading (Performance)
Unit Title: Future Prospects for Computer Hardware

Contents of Unit:
1. Demand versus Price
2. A New Technology
3. A Workstation Approach
4. Communications Hardware
5. The Office of Tomorrow

Unit Objectives:
Upon completion of this unit, the student will be able to:
1. Demonstrate a knowledge of the microcomputer’s past and present, and understand the future prospects for computer hardware.

Equipment and Materials Required:

Lecture:
Text and Student’s Lecture Guide #15

Hardware and Materials:
Tool box
Microcomputer

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Tour
Demonstration
Discussion
Learning Activities:

Lecture:
   Read Computer Shopper magazine

Laboratory:
   Complete Student’s Lab Guide #15

Evaluation:

Lecture:
   Preparation for final exam

Laboratory:
   Lab #15 for grading (Performance)