ABSTRACT
        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
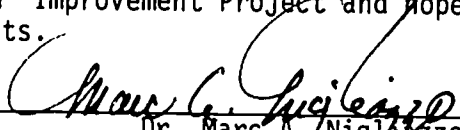
FOREWORD

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. Niglazzo
Vice President and Dean of Instruction
June 30, 1987

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REGION II

CURRICULUM IMPROVEMENT PROJECT

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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

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:

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

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.

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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:

Week No.	Description	Due	Assignment
1	General Introduction and Computer System Today's Equipment – A Service Profile Servicing Your Equipment – The Options	Lab 1	Chap. 1,2,3
2	The Electronic Environment The Computer Can Affect the Environment Preventive Maintenance Disk-Handling Procedures File Management	Lab 2	Chap. 4
3	General Skills Documentation and Advice Test Instruments	Lab 3	Chap. 5
4	General Principles Checking Discrete Components Electromechanical Parts Integrated Circuits (IC's)	Lab 4 Exam 1	Chap. 6
5	Specific IC Devices The System	Lab 5	Chap. 7
6	Z80 68000 8086/8088 80286/80386 Others	Lab 6	**
7	General Architecture of a Microcomputer Why Assembly Language? Assemblers and Loaders Debuggers Number System Instruction Set Execution of an Assembly Language	Lab 7	**
8	Inside a Disk Drive Service Problems with Diskettes and Disk-Drives Maintaining Disk Drives Troubleshooting Disk Drives Alignment and Adjustments Checking Individual Circuits and Mechanisms.	Lab 8	Chap. 8

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Week No.	Description	Due	Assignment
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.

STUDENT LECTURE GUIDE

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 1

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	TTL	transistor
diodes	resistor	voltage
RAM	DC	AC
electromechanical	discrete	MTBF
modems	controllers	disk drives
cables	monitors	frequency
switches	connectors	burn in

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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)

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Terms (Vocabulary):

spikes	transients	susceptible
surge	motor	brownout
power supplies	intermittent	current flow
FET	CMOS	conductive
static	softener	filter
varistor	short-circuits	coil
MHz	fuzzy	coaxial
insulator	FRD	DOS
bugs	shield	interference

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STUDENT'S GUIDE (LECTURE)

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 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
heat sink	wire strippers	tweezers
wrenches	nut drivers	transformer
disk exerciser	logic state analyzer	solenoids

STUDENT'S GUIDE (LECTURE)

Unit 4

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

STUDENT'S GUIDE (LECTURE)

Unit 5

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
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.

Learning Activities:

Lecture:
     Read Chapter 7

Laboratory:
     Complete Student's Lab Guide #5.

Evaluation:

Lecture:
     None

Laboratory:
     Lab #5 for grading (Performance)

Terms (Vocabulary):

AND gates	OR gates	truth table
tristate	chip	memory trick
buffers	flip-flop	RS flip-flop
clock	JK flip-flop	comparators
counters	dividers	binary number
shift register	serial-in	parallel-in
multiplexer	address	refresh signals
sectors	tracks	density
sector adjustment	spiral motor	index timing
belt tension	write protect	index detector

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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)

MSI	solid state	interfacing
data bugging	sequential logic	counters
stackable leads	logic system	bits
byte	word	8-bit
16-bit	32-bit	trainer
prestable	addresses	instruction set
superfluous	block diagrams	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	PCL	PCH
status flag	index resister	accumulator
buffer	clock	crystal
drivers	bootstrap	ports
megahertz	IR	paging
loaders	assemblers	mnemonics
macros	debuggers	micro
resident	one-pass assemblers	two-pass assembler
global	symbolic	meta-assembler
pseudo-operations	label	operand

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STUDENT'S GUIDE (LECTURE)

Unit 8

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

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STUDENT'S GUIDE (LECTURE)

Unit 9

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

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	PNP
high frequency	low frequency	gate thyristor
channel fet	semiconductor	intersil
national	Motorola	Texas Instruments
Harris	monolithic memory	pinouts
timers		

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STUDENT'S GUIDE (LECTURE)

Unit 11

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)

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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

STUDENT'S GUIDE (LECTURE)

Unit 12

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

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STUDENT'S GUIDE (LECTURE)

Unit 13

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	scope	ripple
RAM's	IC's	heat sink
TTL	slave	grawing down
oscillator	SCR	battery

CST 2403: Fundamentals of Hardware

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)

STUDENT'S GUIDE (LECTURE)

Unit 15

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

STUDENT'S GUIDE (LABORATORY)

Unit 1

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)

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 2

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.   Decribe 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)

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 excercise 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)

CST 2403:   Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 4

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

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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)

CST 2403:   Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 5

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

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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)

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 6

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)

CSC 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 7

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. Execeution 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 diskettee
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)

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 8

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)

STUDENT'S GUIDE (LABORATORY)

Unit 9

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)

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 10

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)

CST 2403:   Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 12

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)

CST 2403:   Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 13

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)

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CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 14

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)

CST 2403: Fundamentals of Hardware

<u>STUDENT'S GUIDE (LABORATORY)</u>

Unit 15

<u>Unit Title:</u>   Future Prospects for Computer Hardware

<u>Time Required:</u>

2 hours

<u>Contents of Unit:</u>

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

<u>Unit Objectives:</u>

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.

<u>Equipment and Materials Required:</u>

Tool box
Microcomputer

<u>Learning Activities:</u>

Complete Student's Lab Guide #15

<u>Steps:</u>

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.

<u>Evaluation:</u>

Lab #15 for grading (Performance)

INSTRUCTOR'S COURSE SYLLABUS

CST 2403:   Fundamentals of Hardware

INSTRUCTOR'S COURSE SYLLABUS

Course Title: Fundamentals of Hardware

Course Number:

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

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:

How to Maintain and Service Your Small Computer, by John G.
        Stephenson and Bob Cahill; Howard W. Sams & Co., A
        Division of Macmillan, Inc., 1986.

References:

Microcomputer Troubleshooting & Maintenance, by Henry F.
    Beechhold; Prentice Hall Press, New York, 1987.

Troubleshooting Microprocessors & Digital Logic, by Robert
    Goodman; Tab Books, Inc., 1986.

Computer Hardware and Organization, by M.E. Sloan; Science
    Research Associates, Inc., Chicago, 1973.

An Introduction to Assembly Language for The 8086 Family, by
    Thomas P. Skinner; John Wiley & Sons, Inc., New York,
    1985.

8080A-8085 Assembly Programming, by Lance A. Leventhal;
    Osborne/McGraw-Hill,1978.

Programming 6502, by Rodney Zaks; Sybex Inc., 1980.

AC Circuits Reference Manual, by Control Data Educational
    Company, 1979.

Direct Current Reference Manual, by Control Data Educational
    Company, 1979.

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

Educational Systems, by Heathkit/Zenith, 1983.

Computer Shopper, by Computer Shopper of Titusville,
    Inc.,1987.

SDK-86 System Design Manual, by Intel Corporation.

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.

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.
3. Utilize manufacturer's reference materials.
4. Determine reason for microcomputer
    malfunctions.
5. Perform power-on and power-off procedures.
6. Load, start, and unload disk drives.
7. Keep logs of equipment problems.
8. Perform minor maintenance on microcomputer.
9. Initiate procedures for equipment repair.

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

CST 2403:   Fundamentals of Hardware

INSTRUCTOR'S GUIDE

Unit 1

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

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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)

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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)

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Unit 4

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.
       3.   Stimulate circuits for test.
       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

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Learning Activities:

Lecture:
    Read Chapter 6

Laboratory:
    Complete Student's Lab Guide #4

Evaluation:

Lecture:
    Exam #1

Laboratory:
    Lab #4 for grading (Performance)

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Unit 5

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

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Learning Activities:

    Lecture:
        Read Chapter 7

    Laboratory:
        Complete Student's Lab Guide #5

Evaluation:

    Lecture:
        None

    Laboratory:
        Lab #5 for grading (Performance)

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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)

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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

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Learning Activities:

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

Laboratory:
    Complete Student's Lab Guide #7

Evaluation:

Lecture:
    None

Laboratory:
    Lab #7 for grading (Performance)

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Unit 8

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 9

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)

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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.

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)

INSTRUCTOR'S GUIDE

Unit 11

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

Learning Activities:

Lecture:
    Read Chapter 12

Laboratory:
    Complete Student's Lab Guide #13

Evaluation:

Lecture:
    None

Laboratory
    Lab #13 for grading (Performance)

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)

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Unit 15

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 <u>Computer Shorper</u> magazine

Laboratory:
Complete Student's Lab Guide #15

Evaluation:

Lecture:
Preparation for final exam

Laboratory:
Lab #15 for grading (Performance)