DOCUMENT RESUME

ED 311 223 CE 053 208

TITLE	Advanced Electricity. Microprocessors and Robotics. Curriculum Development. Bulletin 1803.
INSTITUTION	Southeastern Louisiana Univ., Hammond.
SPONS AGENCY	Louisiana State Dept. of Education, Baton Pouge. Div. of Vocational Education.
PUB DATE	Feb 87
NOTE	232p.
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052) -- Tests/Evaluation Instruments (160)
EDRS PRICE	MF01/PC10 Plus Postage.
DESCRIPTORS	Competence; Competency Based Education; Computer Software; *Course Content; Course Organization; *Electricity; *Electronics; Equipment; High Schools; Industrial Arts; Learning Activities; *Microcomputers; *Robotics; State Curriculum Guides; Student Organizations; Technical Education; Technological Advancement; Test Items; Units of Study; Vocational Education
IDENTIFIERS	Louisiana

ABSTRACT

This model instructional unit was developed to aid industrial arts/technology education teachers in Louisiana to teach a course on microprocessors and robotics in grades 11 and 12. It provides guidance on model performance objectives, current technology content, sources, and supplemental materials. Following a course description, rationale, and content outline time schedule, the guide contains 12 instructional units covering the following topics: review of basic electricity/electronics; past and future of computing; digital electronics; microprocessors; introduction to computer hardware; introduction to software; introduction to robotics and automation; classification of robots; interfacing; application of robots; impact of robotics on society; and teaching microprocessors and robotics through competitive events. Each unit consists of an introduction; competencies; general performance objectives/goals; specific performance objectives and mastery criteria; methodology; suggested interest approaches; unit outline; subject matter content related to specific performance objectives and learning activities; activity sheets; test with answer key; evaluation and testing methods; and equipment and supply list. (KC)

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CURRICULUM DEVELOPMENT

1987

Office of Vocational Education

Bulletin 1803

LOUISIANA DEPARTMENT OF EDUCATION

THOMAS G. CLAUSEN, Ph.D.

State Superintendent

STATE OF LOUISIANA

DEPARTMENT OF EDUCATION

BULLETIN 1803

ADVANCED ELECTRICITY

MICROPROCESSORS AND ROBOTICS

Issued By

Office of Vocational Education

Elaine P. Webb, Ed.D.
Assistant Superintendent

Thomas G. Clausen, Ph.D.
State Superintendent

February, 1987

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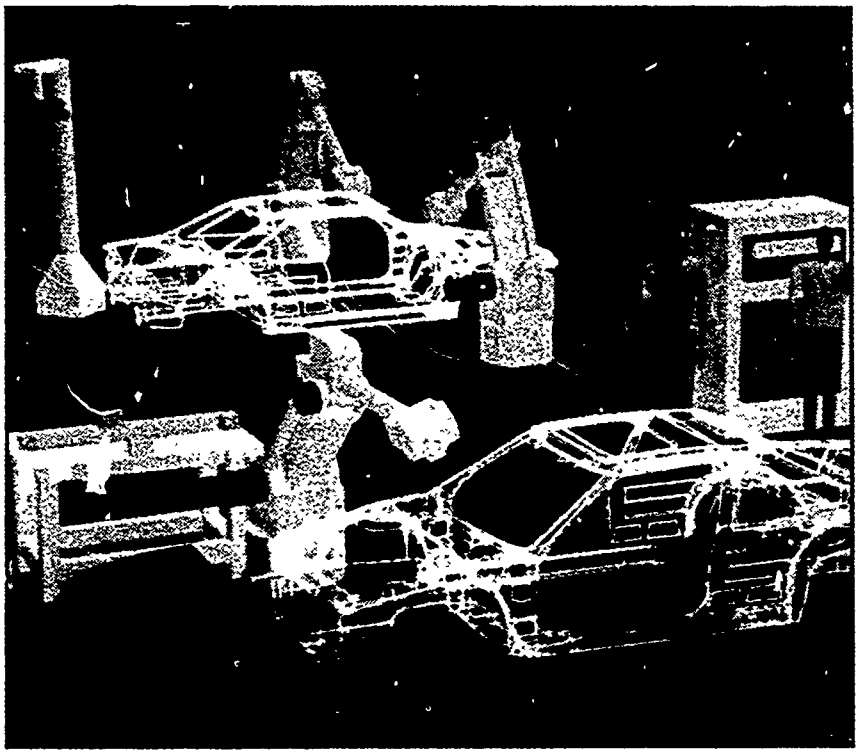

Microprocessor and Robotics Curriculum Guide for Industrial Arts/Technology Education in Louisiana

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Funded by
The State of Louisiana
Department of Education
Office of Vocational Education

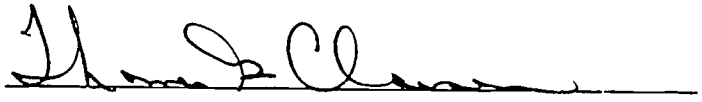
Southeastern Louisiana University
February 1987

FOREWORD

This Curriculum Guide, Microprocessors and Robotics, was produced as a result of a project funded by the Louisiana State Department of Education to Southeastern Louisiana University, Department of Industrial Technology. This model unit represents the concerted efforts of Industrial Arts/Technology Education teachers throughout the State of Louisiana. This Unit has been field tested and evaluated.

This Model Instructional Unit was developed for the express purpose of aiding experienced as well as beginning Industrial Arts/Technology Education teachers. It provides model performance objectives, current technology content, sources, and supplemental materials.

We believe that this Unit will make a major contribution to the improvement of technology instruction in Industrial Arts/Technology Education in Louisiana.



Thomas G. Clausen, Ph.D.
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ACKNOWLEDGEMENTS

This publication represents the cooperative efforts of personnel in the Industrial Technology Department, Southeastern Louisiana University, and the Industrial Arts Education Section in the Office of Vocational Education, Louisiana State Department of Education. Special recognition goes to Duane D. Dunlap who served as Project Director and to Bart Moore, Howard Williams, and Gamini Weerasekera who served as Project Curriculum Specialists in the development of the guide.

Elaine Webb, Ed.D.
Assistant Superintendent
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ADVANCED ELECTRICITY

Course Description:

This is an advanced course in electricity that introduces more complex topics in the area of electricity. Emphasis is placed on the technology rather than skill development. The content presented provides a sound basis for moving into a highly technical microprocessor and robotics program.

Prerequisites:

General Industrial Arts Could Be Included In
Basic Electricity/Electronics
(Algebra I and II are desirable)

Target Grade Level:

This course is targeted for students in grades eleven and twelve.

Course Length:

Total number of weeks for instruction: 36

Unit of Credit: one (1)

TABLE OF CONTENTS

RATIONALE

The Advanced Electricity-Microprocessor/Robotics curriculum guide developed by the Louisiana State Department of Education emphasizes all components of advanced electricity technology.

During the past decade, numerous significant technological changes have taken place in the industrial work place. Most recognizable among these are the use of microcomputers, computer-aided design and drafting (CAD/D), and computer-aided manufacturing (CAM). The latter of the three, CAM, includes the use of microprocessors and robots as part of the manufacturing process. Industrial robots have been in the workplace since the early 1960's, and today they have become an integral part of automated systems within existing manufacturing processes. The coupling of microprocessors and computers to robots has made this modern application of robotics possible, and has contributed to the advent of "high technology." This introduction of "high technology" into the workplace is being referred to as the dawning of the second industrial revolution.

Because of the social, economic, and production ramifications involved, public schools, technical schools, colleges and universities, research organizations, and institutes are examining the involvement of high technology (including robotics) in the areas of education, manufacturing, construction, medicine, agriculture, and space exploration. Industrial Arts/Technology Education teachers must also examine implications of the impact of robotics and other areas of high technology and incorporate their study into secondary education curricula if the curricula are to accurately reflect the technological advancements occurring not only in industry, but in society as a whole. Finally, I would like to express sincere thanks to Virginia Hodgeson for all of the word processing, proofing and time put into this project.

Duane D. Dunlap
Project Director

CONTENT OUTLINE

MICROPROCESSOR/ROBOTICS TIME SCHEDULE

UNIT	TITLE	TIME (CLASS PERIODS)
I	Review of Basic Electricity	20
II	Past and Future of Computing	4
III	Digital Electronics	24
IV	Microprocessors	18
V	Introduction to Computer Hardware	14
VI	Introduction to Software	18
VII	Introduction to Robotics and Automation	10
VIII	Classifications of Robots	12
IX	Interfacing	10
X	Applications	35
XI	Impact of Robotics on Society	5
XII	Teaching Microprocessors and Robotics Through AIASA Competitive Events	10

UNIT I

REVIEW OF BASIC ELECTRICITY/ELECTRONICS

INTRODUCTION

As technology continues to expand and gain entry into every facet of human existence, our society must adapt to those changes in order to benefit from the advantages technology can provide or be relegated to inferior economic world status.

Computer-aided instruction, design, and manufacturing have profoundly changed how we learn, how we plan, and how we live. This introductory course in microprocessors and robotics is intended to peak student interest and desire in continued study and to challenge them to attend the university and/or vocational technical school where their skills and potential can be fully developed.

Our study of microprocessors and robotics begins with a review of those pertinent facts learned in the Basic Electricity/Electronics course. Upon completion of this unit, the student will be able to operate electrical test equipment safely and to calculate electrical values accurately in AC and DC circuits.

COMPETENCIES

1. Know and practice safety rules for the laboratory.
2. Correctly define and calculate electrical circuit values.
3. Select and use the appropriate test equipment performing electric measurements.
4. Convert electrical values into scientific notation.
5. Detect faults in electrical connections and conductors.
6. Explain the operation of magnetic devices.

GENERAL PERFORMANCE OBJECTIVES/GOALS

1. Recognize and demonstrate safe laboratory procedures.
2. Correctly define and calculate voltage, current, resistance and power in terms of Ohm's law and Joule's law.

3. Use appropriate test equipment, measure alternating current and voltage, as well as peak to peak and root mean square voltages.
4. Translate electrical values into their correct scientific notation format.
5. Safely troubleshoot electrical shorts and opens with an ohmmeter.
6. Recognize schematic symbols for magnetic devices and determine their effect in a circuit.

SPECIFIC PERFORMANCE OBJECTIVES AND MASTERY CRITERIA

1.1 On a written test, students will demonstrate a thorough knowledge of safety rules by solving problems related to personal safety.

1.2 On a written test, students will demonstrate a thorough knowledge of unsafe laboratory practices that should be avoided by answering questions relevant to lab safety.

2.1 On a written test students will demonstrate knowledge of electrical terms and their definitions by correctly identifying and associating them.

2.2 On a written test, students will demonstrate knowledge of the common abbreviations for electrical terms by correctly associating the abbreviation with the term.

2.3 On a written test, students will demonstrate knowledge of schematic symbols by correctly associating the symbol with the term.

3.1 On a written test, students will demonstrate knowledge of Ohm's law and Joule's law by accurately defining volts, ohms, amps, and watts.

3.2 On a written test, students will demonstrate knowledge of Ohm's law and Joule's law by accurately calculating the value of volts, ohms, amps, and watts present in the purely resistive DC circuits given.

4.1 On a written test, students will demonstrate knowledge of test equipment by differentiating among the analog multimeter (VOM), the digital multimeter (DMM), and the oscilloscope ('scope), according to their capabilities and use.

4.2 In a supervised exercise, students will demonstrate knowledge of the safe and correct use of an analog multimeter by taking voltage, current, and ohm measurements.

4.3 In a supervised exercise, students will demonstrate knowledge of the safe and correct use of a digital multimeter by taking voltage, current and ohm measurements.

4.4 In a supervised exercise, students will demonstrate knowledge of the safe and correct use of an oscilloscope by taking DC voltage measurements.

5.1 On a written test, students will demonstrate knowledge of scientific notation by converting measured electrical values to the following notations: pico, nano, micro, milli, kilo, mega, giga.

6.1 In a supervised exercise, students will demonstrate knowledge needed to measure peak, peak to peak AC voltages safely with an oscilloscope, and calculate the corresponding rms (effective) voltage accurately.

7.1 On a written test, students will demonstrate knowledge of AC resistive circuit by calculating current flows, voltage drops, and power dissipations.

8.1 In a supervised exercise to troubleshoot electrical shorts and opens, students will demonstrate knowledge of fault isolation and detection with the aid of an ohmmeter.

9.1 On a written test, students will demonstrate knowledge of magnetic devices by correctly associating schematic symbols, use, and theory of operation for the following: electromagnets, inductors, transformers, relays, buzzers, generators, and motors.

METHODOLOGY

Students need extensive laboratory time to become proficient in the use of test equipment. They should begin by reviewing terms, schematic symbols, and electrical relationships. Safety should be emphasized throughout every lecture or laboratory experience.

As students study the various kinds of resistive circuits (series, parallel, and series parallel), they should be required to calculate all the expected electrical values before taking the actual measurements. Should time permit, other kinds of test equipment may be studied, including a frequency counter, pulse detectors, and signal injectors.

SUGGESTED INTEREST APPROACHES

1. Emphasize laboratory work and reports, for it is in the laboratory that theory is proven and experience is gained.
2. Require students to maintain a notebook divided into at least four sections. One section can be used to collect safety rules and other handouts. Another section may be used for class notes, a third section for lab reports; and a fourth section to collect old tests and quizzes.

3. Encourage students to work together, as this improves safety, retention and is typical of many work environments.
4. As knowledge and skill increase, provide other kinds of multimeters for students to use, since knowledge of the use of multimeters is transferable. Other work sites may not have the same brand or model of test equipment that is in your laboratory.

UNIT I OUTLINE

REVIEW OF BASIC ELECTRICITY/ELECTRONICS

I. Laboratory safety
   1. Safety rules and regulations
   2. Unsafe practices

II. Electrical components and terms
   1. Definitions
   2. Abbreviations
   3. Schematic symbols

III. Ohm's and Joule's Laws in direct current (DC) circuits
   1. Definitions
   2. Calculations

IV. Test equipment
   1. Analog volt, ohm, milliamp meter (VOM)
   2. Digital volt, ohm, milliamp meter (DMM)
   3. Oscilloscope ('scope)

V. Scientific notation and conversion
   1. pico
   2. nano
   3. micro
   4. milli
   5. kilo
   6. mega
   7. giga

VI. Alternating current (AC) wave form characteristics and measurements
   1. Peak voltage
   2. Peak to peak voltage
   3. Root mean squared or effective voltage

VII. Ohm's and Joule's Laws calculations in an AC circuit

VIII. Troubleshooting with an ohmmeter
1. Electrical shorts
2. Electrical opens

X. Magnetic devices--their schematic symbols, use, and operation
1. Electromagnets
2. Inductors
3. Transformers
4. Relays
5. Buzzers
6. Generators
7. Motors

SPECIFIC PERFORMANCE OBJECTIVES

1.1 On a written test, students will demonstrate a thorough knowledge of safety rules by solving problems related to personal safety.

Subject Matter Content	Learning Activities
Equipment and Personal Safety	Reviewing safety rule handouts, posters, and discussing reasoning behind the rule.

1.2 On a written test, students will demonstrate a thorough knowledge of unsafe laboratory practices that should be avoided by answering questions relevant to lab safety.

Subject Matter Content	Learning Activities
Safe Laboratory Practices	Reviewing lab rule handouts, discussing what practices should be avoided and why they should be avoided for a unit test.

2.1 On a written test, students will demonstrate knowledge of electrical terms and their definitions by correctly identifying and associating them.

Subject Matter Content	Learning Activities
Electrical Components and Terms	1. Identifying components individually and within electrical equipment. 2. Analyzing components connected in series, parallel, and series parallel circuits.

2.2 On a written test, students will demonstrate knowledge of the common abbreviations for electrical terms by correctly associating the abbreviation with the term.

Subject Matter Content	Learning Activities
Abbreviations for Electrical Terms	Identifying the abbreviations for electrical terms.

2.3 On a written test, students will demonstrate knowledge of schematic symbols by correctly associating the symbol with the term.

Subject Matter Content	Learning Activities
Schematic Symbols	Examining electrical equipment schematic diagrams and associating schematic symbols with terms for a unit test.

3.1 On a written test, students will demonstrate knowledge of Ohm's law and Joule's law by accurately defining volts, ohms, amps, and watts.

Subject Matter Content	Learning Activities
Definitions of Ohm's and Joule's Laws	Comparing voltage to water pressure, resistance to pipe size and length, current flow to water flow, and electrical power to the work done by water flowing against a water wheel, as a means of defining the laws.

3.2 On a written test, students will demonstrate knowledge of Ohm's law and Joule's Law by accurately calculating the value of volts, ohms, amps, and watts present in the purely resistive DC circuits given.

Subject Matter Content	Learning Activities
Calculations of Ohm's and Joule's Laws	1. Observe changes in the value of current and power when voltage or resistance is changed. 2. Examine the relationship between total resistance and the individual resistors in series and in parallel circuits. 3. Calculate current flows, voltage drops and power dissipations for a unit test.

4.1 On a written test, students will demonstrate knowledge of test equipment by differentiating among the analog multimeter (VOM), the digital multimeter (DMM), and the oscilloscope ('scope), according to their capabilities and use.

Subject Matter Content	Learning Activities
Test Equipment	1. Determine the capabilities of the VOM, DMM, and the 'scope. 2. Reviewing safety rules associated with test equipment.

4.2 In a supervised exercise, students will demonstrate knowledge of the safe and correct use of an analog multimeter by taking voltage, current, and ohm measurements.

Subject Matter Content	Learning Activities
Using an Analog Multimeter (VOM)	1. Observe the instructor's correct and safe use of a VOM to measure current, voltage, and resistance. 2. Performing voltage, current, and resistance measurements by individual students while other students verify safe and correct procedure.

4.3 In a supervised exercise, students will demonstrate knowledge of the safe and correct use of digital multimeter by taking voltage, current and ohm measurements.

Subject Matter Content	Learning Activities
Using a Digital Multimeter (DMM)	1. Observe the instructor's correct and safe use of a DMM to measure current, voltage, and resistance. 2. Perform voltage, current and resistance measurements by individual students while other students verify safe and correct procedure using the DMM.

4.4 In a supervised exercise, students will demonstrate knowledge of the safe and correct use of an oscilloscope by making DC voltage measurements.

Subject Matter Content	Learning Activities
Using an Oscilloscope ('scope)	1. Observe the instructor's correct and safe use of an 'scope to measure DC voltage.

2. Perform DC voltage measurements by the students while other students verify correct and safe procedure on a unit test.

5.1 On a written test, students will demonstrate knowledge of scientific notation by converting measured electrical values to the following notations: pico, nano, micro, milli, kilo, mega, giga.

Subject Matter Content	Learning Activities
Scientific Notation	1. Reviewing the term, abbreviation, and the meaning of each of the most commonly used scientific notation prefixes: pico, nano, micro, milli, kilo, mega, giga. 2. Noting the powers of ten and associating them with their common prefixes. 3. Examining the decimal equivalencies of each prefix. 4. Determining equivalencies between prefixes, i.e., micromicro = pico for a unit test.

6.1 In a supervised exercise, students will demonstrate knowledge needed to measure peak and peak to peak AC voltages safely with an oscilloscope, and then calculate the corresponding rms (effective) voltage accurately.

Subject Matter Content	Learning Activities
Alternating Current (AC) Wave Form Characteristics	1. Distinguishing the characteristics of a symmetrical AC voltage wave form and labeling its parts.

2. Observing as the instructor safely and correctly measures AC voltage using an Oscilloscope.
3. Performing AC voltage measurements to determine the peak voltage, the peak to peak voltage, and the root mean squared or effective voltage for a unit test, while other students verify correct and safe procedure.

7.1 On a written test, students will demonstrate knowledge of AC resistive circuits by calculating current flows, voltage drops, and power dissipations.

Subject Matter Content	Learning Activities
Alternating Current (AC) Resistive Circuits	1. Observing changes in the value of current and power when voltage or resistance is changed. 2. Practicing resistance formulas that can be used to determine total resistance. 3. Calculating current flows, voltage drops and power dissipations in AC resistive circuits for a unit test.

8.1 In a supervised exercise to troubleshoot electrical shorts and opens, students will demonstrate knowledge of fault isolation and detection with the aid of an ohmmeter.

Subject Matter Content	Learning Activities
Troubleshooting with an Ohmmeter	1. Determining electrical shorts and their causes and discussing consequences of electrical shorts at critical points of any electrical device. 2. Determining electrical opens and their causes and discussing consequences of the opens at critical points of an electrical circuit. 3. Practicing the safe and correct use of an ohmmeter to troubleshoot electrical shorts and opens by inserting obvious shorts across resistors and removing jumper wires to simulate open resistors within a breadboard circuit made by the students in preparation for a unit test.

9.1 On a written test, students will demonstrate knowledge of magnetic devices by correctly associating schematic symbols, use, and theory of operation for the following: electromagnets, inductors, transformers, relays, buzzers, generators, and motors.

Subject Matter Content	Learning Activities
Magnetic Devices	1. Examining the actual devices and recording their schematic symbols. 2. Studying circuits and schematic diagrams containing electromagnets, inductors, transformers, relays, buzzers, generators, and motors to determine their use in preparation for a unit test.

ACTIVITY SHEET

The very nature of Industrial Arts/Technology Education is to provide technical familiarization through hands-on activities, hence teachers should provide as much or as many opportunities for learning activities as are possible. Some suggestions include the following:

1) Actual electronic components obtained from old television sets, computers, radios, toasters, etc.
2) Schematic diagrams.
3) Breadboarding experiences.
4) Kit building and project building.
5) Troubleshooting of teacher-inserted faults.
6) Movies, VCR, reference books on the various fields to which electronics is being applied, i.e., communication, entertainment, medicine, security, education, and manufacturing.

UNIT I TEST

1. Under what conditions may rules for lab, personal, or equipment safety be ignored?

2. Match the symbol with its term and record its corresponding number next to the term in the space provided:

TERMS		SYMBOLS	
_____ a.	current	1.	w
_____ b.	voltage	2.	P_T
_____ c.	power	3.	P
_____ d.	resistance	4.	R_3
_____ e.	amps	5.	R
_____ f.	watts	6.	I_3
_____ g.	volts	7.	V_3
_____ h.	ohms	8.	⏜
_____ i.	voltage across 3 resistors	9.	I
_____ j.	current through resistor 3	10.	v
_____ k.	tal power	11.	V
_____ l.	resistance of resistor 3	12.	a

3. Match the schematic diagram figure 1 with its term and record the corresponding number next to the term in the space provided:

_____ a. a battery
_____ b. wires that connect
_____ c. a transformer
_____ d. wires that do not connect
_____ e. a motor
_____ f. a fuse
_____ g. a generator
_____ h. a switch
_____ i. a pilot lamp
_____ j. a resistor
_____ k. an inductor
_____ l. an ohmmeter

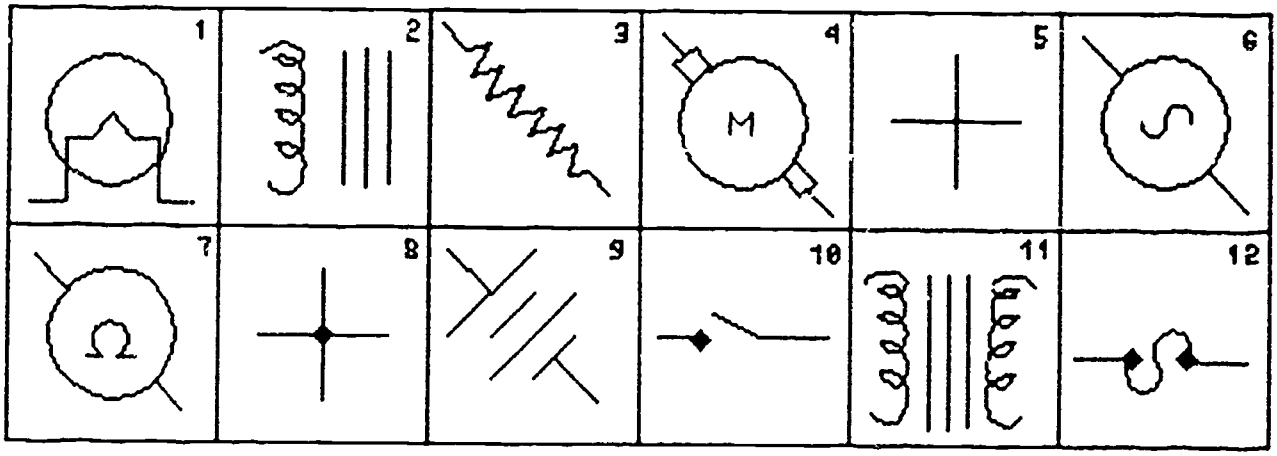


FIGURE 1

4. Fill in the chart using the schematic drawing (Figure 2) and your knowledge of Ohm's and Joule's Laws. Hint: Use fractions.

V_1=	V_2=	V_3=	V_4=	V_T= 25v
R_1= 4Ω	R_2= 120Ω	R_3= 40Ω	R_4= 16Ω	R_T=
I_1=	I_2=	I_3=	I_4=	I_T=
P_1=	P_2=	P_3=	P_4=	P_T=

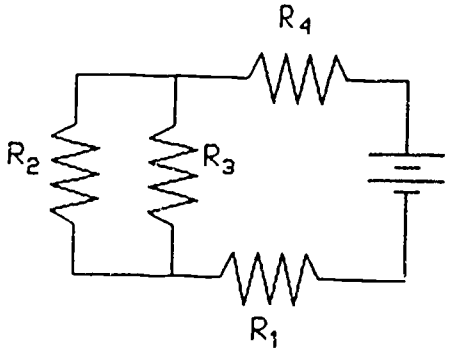


FIGURE 2

5. Using figure 3 taken from an Oscilloscope presentation, calculate the following:

_____ peak voltage

_____ peak to peak voltage

_____ rms voltage

The volts/cm switch is at 2; the time/cm switch is at 5 msec; the probe is configured for direct input.

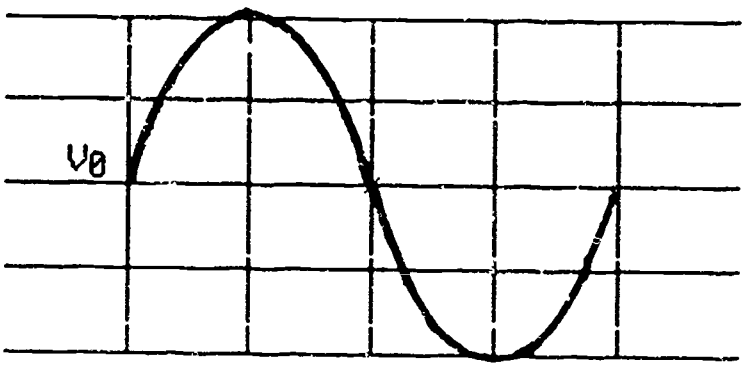
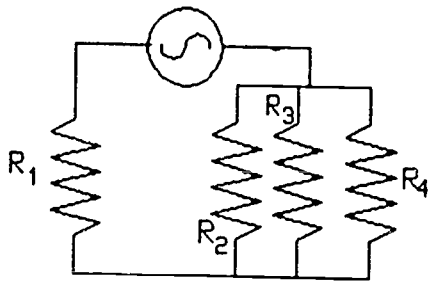


FIGURE 3

6. Match the number with its prefix by writing the corresponding letter next to the prefix:

_____	1. giga	a)	.000 000 001
_____	2. mega	b)	.000 001
_____	3. kilo	c)	1,000
_____	4. milli	d)	10^{9}
_____	5. micro	e)	10^{-3}
_____	6. nano	f)	10^{-12}
_____	7. pico	g)	1,000,000

7. Complete the following chart (figure 4). Be sure to give rms values.



V_1	V_2	V_3	V_4	V_T RMS
R_1 1KΩ	R_2 6KΩ	R_3 2KΩ	R_4 3KΩ	R_T
I_1	I_2	I_3	I_4	I_T
P_1	P_2	P_3	P_4	P_T

FIGURE 4

8. Why do safety rules require that a circuit be de-energized before using an ohmmeter to test for shorts or opens?

9. Match the magnetic device with a statement of its use and record the corresponding number in the space provided:

_____ a. motor	1) converts electrical energy into mechanical energy
_____ b. transformer	2) used to lift metal objects or hold them fast
_____ c. buzzer	3) opposes current as frequency increases
_____ d. relay	4) changes the form of input signal
_____ e. generator	5) a remotely controlled switch
_____ f. inductor	6) the amount of current flowing can change its sound
_____ g. electromagnet	7) converts mechanical energy into electrical energy

UNIT I TEST KEY

1. Never

2. a) 9
   b) 11
   c) 3
   d) 5
   e) 12
   f) 1
   g) 10
   h) 8
   i) 7
   j) 6
   k) 2
   l) 4

3. a) 9
   b) 8
   c) 11
   d) 5
   e) 4
   f) 12
   g) 6
   h) 10
   i) 1
   j) 3
   k) 2
   l) 7

4.

V_1 2v	V_2 15v	V_3 15v	V_4 8v	V_T 25v
4Ω	120Ω	40Ω	16Ω	50Ω
1/2a	1/8a	3/8a	1/2a	1/2a
1w	1 7/8w	5 5/8w	4w	12½w

FIGURE 2

4. (continued) CALCULATIONS:

Computation of R_T

1) Parallel Resistance of R_2, R_3 (R_A)

$$R_A = \frac{R_2 \times R_3}{R_2 + R_3} = \frac{120 \text{ ohms} \times 40 \text{ ohms}}{120 \text{ ohms} + 40 \text{ ohms}} = \frac{4800 \text{ ohms}}{160 \text{ ohms}} = 30 \text{ ohms}$$

2) Add Series Resistance

$$R_T = R_1 + R_A + R_4 = 4 \text{ ohms} + 30 \text{ ohms} + 16 \text{ ohms} = 50 \text{ ohms}$$

Computation of I_T

$$I_T = V_T / R_T = 25 \text{ Volts} / 50 \text{ ohms} = .5 \text{ Amps or } 500 \text{ milliamps}$$

Computation of P_T

$$P_T = I_T \times V_T = .5 \text{ Amps} \times 25 \text{ Volts} = 12.5 \text{ Watts}$$

Computation of V_{RA}

$$V_{RA} = I_{RA} \times R_A = .5 \text{ Amps} \times 30 \text{ ohms} = 15 \text{ Volts}$$

Computation of I_{RA}, I_1, I_2, I_3, I_4

I_{RA} = series current = .5 Amps

$I_{RA} = I_2 + I_3 = .125 \text{ Amps} + .375 \text{ Amps} = .5 \text{ Amps or } 500 \text{ milliamps}$

$I_2 = V_2 / R_2 = 15 \text{ Volts} / 120 \text{ ohms} = .125 \text{ Amps or } 125 \text{ milliamps}$

$I_3 = V_3 / R_3 = 15 \text{ Volts} / 40 \text{ ohms} = .375 \text{ Amps or } 375 \text{ milliamps}$

$I_T = I_1 = I_4 = I_{RA}$ = series current = .5 Amps or 500 milliamps

Computation of V_1, V_2, V_3, V_4

$V_1 = I_1 \times R_1 = .5 \text{ Amps} \times 4 \text{ ohms} = 2 \text{ Volts}$

$V_2 = V_3 = V_{RA} = 15 \text{ Volts}$

$V_4 = I_4 \times R_4 = .5 \text{ Amps} \times 16 \text{ ohms} = 8 \text{ Volts}$

$V_T = V_1 + V_{RA} + V_4 = 2 \text{ Volts} + 15 \text{ Volts} + 8 \text{ Volts} = 25 \text{ Volts}$

Computation of P_1, P_2, P_3, P_4

$P_1 = I_1 \times V_1 = .5 \text{ Amps} \times 2 \text{ Volts} = 1 \text{ Watt}$

$P_2 = I_2 \times V_2 = .125 \text{ Amps} \times 15 \text{ Volts} = 1.875 \text{ Watts}$

$P_3 = I_3 \times V_3 = .375 \text{ Amps} \times 15 \text{ Volts} = 5.625 \text{ Watts}$

$P_4 = I_4 \times V_4 = .5 \text{ Amps} \times 8 \text{ Volts} = 4 \text{ Watts}$

5.

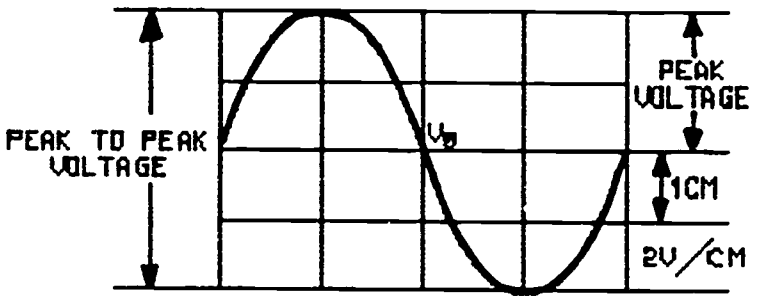


FIGURE 3

V_P = v/cm * cm 2v/cm*2cm

$V_P = 4V_P$

V_{P-P} = v/cm * cm 2v/cm *4cm

$V_{P-P} = 8V_{P-P}$

V_{rms} = .707 * V_P .707 * $4V_P$

$V_{rms} = 2.828v_{rms}$

NOTE: The time/cm switch position is not used to determine voltage. Because the probe is configured for direct readings, the voltage at the probe is seen volt for volt on the screen.

6. 1) d 4) e 7) f

2) g 5) b

3) c 6) a

7.

V_1 6v	V_2 6v	V_3 6v	V_4 6v	V_T 12v
1KΩ	6KΩ	2KΩ	3KΩ	2KΩ
6ma	1ma	3ma	2ma	6ma
36mw	6mw	18mw	12mw	72mw

FIGURE 4

7. (continued) CALCULATIONS

Computation of R_T

$$R_A = \frac{1}{1/R_2 + 1/R_3 + 1/R_4} = \frac{1}{1/6 \text{ K ohms} + 1/2 \text{ K ohms} + 1/3 \text{ K ohms}}$$

R_A = 1 K ohm

$R_T = R_1 + R_A$ = 1 K ohm + 1 K ohm = 2 K ohm

Computation of V_{rms}

V_{rms} = .707 x V_{peak} = .707 x 19.973 Volts = 12 V_{rms} (rounded)

if $R_1 = R_A$ then $V_1 = V_{RA}$

$V_1 = I_1 \times R_1$ = 6 milliamps x 1 K ohm = 6 Volts

$V_1 = V_{RA}$ = 6 Volts

Computation of I_T, I_1, I_2, I_3, I_4

$I_T = V_T / R_T$ = 12 Volts / 2 K ohms = 6 milliamps

$I_1 = I_T$ = 6 milliamps

$I_2 = V_2 / R_2$ = 6 Volts / 6 K ohms = 1 milliamp

$I_3 = V_3 / R_3$ = 6 Volts / 2 K ohms = 3 milliamps

$I_4 = V_4 / R_4$ = 6 Volts / 3 K ohms = 2 milliamps

Computation of P_T, P_1, P_2, P_3, P_4

$P_T = I_T \times V_{rms}$ = 6 milliamps X 12 Volts = 72 milliwatts

$P_1 = I_1 \times V_1$ = 6 milliamps X 6 Volts = 36 milliwatts

$P_2 = I_2 \times V_2$ = 1 milliamp X 6 Volts = 6 milliwatts

$P_3 = I_3 \times V_3$ = 3 milliamps X 6 Volts = 18 milliwatts

$P_4 = I_4 \times V_4$ = 2 milliamps X 6 Volts = 12 milliwatts

8. An ohmmeter contains its own power supply. Its precision voltage produces a current that varies inversely with resistance. Any voltage from an energized circuit would probably cause too much current to flow and damage the meter.

9. a) 1
b) 4
c) 6
d) 5
e) 7
f) 3
g) 2

EVALUATION AND TESTING

Students will be evaluated by the following guidelines:

1) Completing the final safety test with 100% accuracy.
2) Completing the unit test with at least 70% accuracy.
3) Always working safely and insisting that others do the same.
4) Demonstrating ability to listen and comprehend.
5) Demonstrating ability to read and comprehend.
6) Demonstrating the ability to record notes that provide accurate and complete information needed for future use.
7) Demonstrating ability to troubleshoot faults by correctly interpreting schematic diagrams.
8) Demonstrating ability to make accurate electrical measurements and calculations.
9) Demonstrating ability to determine electrical values accurately from personal measurements and calculations.
10) Demonstrating ability to identify meanings of unknown words or common terms.
11) Demonstrating ability to work cooperatively as a team member.

EQUIPMENT AND SUPPLIES

In addition to the equipment and supplies needed to teach Basic Electricity and Electronics (see Louisiana State Department of Education Curriculum Guide), the instructor may wish to include the following:

1) an analog volt, ohm, milliamp meter (VOM) for every two students;
2) a digital volt, ohm, milliamp meter (DMM) for every two students;
3) a dual trace 10 MHz triggered oscilloscope for every two students;
4) appropriate probes for each piece of test equipment and additional jumper wires;
5) items listed in Appendix I-Activity Sheets;
6) textbooks and supplementary materials selected by the teacher;
7) student notebook divided into four sections to accommodate:
    a) safety rules and procedures
    b) class notes
    c) lab notes
    d) old tests and quizzes

   Student notebooks should be maintained by date and verified at regular intervals by the instructor.

BULLETIN BOARD IDEAS

1. Safety posters produced commercially and by students (ref. Unit 12);
2. Research papers written by students (ref. Unit 12);
3. Functional circuit diagrams;
4. Project of the Month boards containing parts list, schematic, assembly procedure, pictures of completed project;
5. A schedule of television programs that relate to electronics, microprocessors, or robotics and that can be recorded or viewed by students after school.

SUPPLEMENTARY MATERIALS

1. TRANSPARENCIES
   Vocational/Industrial Arts Series--Milliken Publishing Company
2. TEXTBOOKS AND RESOURCE BOOKS
   Basic Electricity: Theory and Practice, by M. Kaufman and J. A. Wilson, McGraw Hill Book Company
3. KITS
   EKI - Electronic Kits International
   Graymark
   Heath
4. SCHEMATICS
   Sam's Photofacts and Sam's Computerfacts
   Howard W. Sams and Company, Inc.
   4300 West 62d Street
   Post Office Box 7092
   Indianapolis, IN 46268
5. FILMS
   VCR Programs

A NOTE TO THE TECHNOLOGY EDUCATION PROFESSIONAL

As a professional, the instructor is expected to update technological skill as teacher and technician on a continuous basis. One way to do this is to attend the Louisiana Industrial Arts Association, International Technology Education Association, Louisiana Vocational Association, American Vocational Association and manufacturer conferences. At many of these conferences, vendors of excellent state-of-the-art equipment, textbooks, and supplementary materials are present. Teachers have the opportunity to inspect these professional products to determine their applicability to the classroom, take sample literature, and leave addresses with the vendors so as to keep abreast of new products, prices and uses.

Often vendors use the feedback they receive from professional educators to modify existing items or create new products that will better serve their customers. Materials received at these conferences can easily be expanded to serve as bulletin board ideas, student projects, or ideas for research papers. All technology educators are urged to join appropriate state and national teacher associations and attend their conferences.

UNIT II

PAST AND FUTURE OF COMPUTING

INTRODUCTION

In order to elevate student awareness of the significant role the computer plays in our world, a brief introduction is needed. Looking back through time will enable the student to become aware of the monumental advances in computing technology. The computer has evolved from a primitive counting mechanism into the single most important controlling device present in the technological world today.

This unit is intended to assist the instructor in bridging the gap from past to present. Provided for the instructor are historical landmarks in computer development, as well as considerations regarding the future impact of the computer on our society. The expressed purpose of this introduction is to increase student awareness of the significant events in the history of computing. Additionally, the student should be able to distinguish those new areas of computing technology we might expect to see in the future and their impact on society.

COMPETENCIES

1. Outline the significant events in the development of computing technology.
2. Distinguish those new areas of computing technology we might expect to see in the future, and their impact on society.

GENERAL PERFORMANCE OBJECTIVES/GOALS

1. Recognize the landmark events in the development of computing technology.
2. Increase awareness of the future trends in computing technology and the impact each will have on society.

SPECIFIC PERFORMANCE OBJECTIVES AND MASTERY CRITERIA

1.1 On a written examination, students will demonstrate their knowledge of the significant events in computing technology by matching the technology with the correct description of either the person, place, time, or significance which relates to that development.

2.1 On a written examination, students will demonstrate their awareness of the future trends in computing

technology by stating one of the trends and describing its impact on society.

METHODOLOGY

Two methodologies seem appropriate for this unit: lecture and outside assignments. Students should be encouraged to research from current periodicals and suggested reference texts those topics considered significant in the development of computing technology. This research should not be limited to just those developments listed in the content outline, but could easily be extended at the preference of the instructor.

Furthermore, a summarizing lecture should be planned to tie in the student research reports and the impact of future computing developments on society.

SUGGESTED INTEREST APPROACHES

1. Assign each student a significant development or future trend to be reported on to the class.
2. Provide a list of suggested reference texts and periodicals for the research projects.
3. Using the time line overhead, stress the exponential proliferation of technology (EPT).
4. In outline form, summarize the significant developments and future trends.

UNIT II

PAST AND FUTURE OF COMPUTING

I. Significant developments

- A. Abacus
- B. Pascaline
- C. Difference and Analytical Engines
- D. Hollerith tabulator
- E. Electronic Numerical Integrator and Calculator (ENIAC)
- F. Stored program concept
- G. Transistor
- H. Integrated circuit

II. Future trends

A. Artificial intelligence/expert systems
B. Computer integrated manufacturing (CIM)
C. Fifth generation computing, parallel processing

SPECIFIC PERFORMANCE OBJECTIVES

1.1 On a written examination, students will demonstrate their knowledge of the significant events in computing technology by matching the technology with the correct description of either the person, place, time, or significance which relates to that development.

Subject Matter Content	Learning Activities
Significant events in computer development	1. Assign significant events in computer development to students for reports to the class. 2. A class lecture should be planned to tie in student reports and insure proper coverage of the material.

2.1 On a written examination, students will demonstrate their awareness of the future trends in computing technology by stating one of the trends and describing its impact on society.

Subject Matter Content	Learning Activities
Future trends in computing technology	1. Current periodicals and textbooks should be made available for students to use in researching future trends in computing technology. Students should be encouraged to report to the class regarding the future of computing and its impact on society.

2. A summarizing lecture should be planned to stress definitions of artificial intelligence, expert systems, fifth generation computing, parallel processing, and computer integrated manufacturing.

ACTIVITY SHEET

1. Give a brief description/definition of the following terms/events as they relate to the development of computing technology.

   A. Abacus

   B. Pascaline

   C. Difference Engine

   D. Analytical Engine

   E. Hollerith tabulator

   F. Electronic Numerical Integrator and Calculator (ENIAC)

   G. Stored program concept

   H. Transistor

   I. Integrated circuit

2. Define the following contemporary computing terms/concepts and discuss their impact on society.

   A. Artificial intelligence (AI)

   B. Expert systems

   C. Computer integrated manufacturing (CIM)

   D. Fifth generation computing

   E. Parallel processing

ACTIVITY SHEET KEY

1. Give a brief description/definition of the following terms/events as they relate to the development of computing technology.

   A. Abacus--a collection of beads on a series of rods or wires, and the position of the beads in relation to one or other end of the frame denotes their number. This is the earliest form of computational device. Date of invention is approximately 4000 B.C.

   B. Pascaline--invented by Blaise Pascal in 1644, this was the first calculating machine.

   C. Difference Engine--designed by Charles Babbage (father of computing) in 1821, a working pilot model was presented to the Royal Astronomical Society in 1822. The main purpose of the Difference Engine was to solve polynomial equations by calculating successive differences between sets of numbers. A complete working model was never completed however, mainly because the technology of the day had not yet evolved enough to produce the gears, cogs, and levers to the exacting tolerances required by Babbage's design. The Difference Engine was nothing more than a special purpose calculator.

   D. Analytical Engine--also designed by Babbage in the 1830's, this was to be a truly programmable computer. This design was never built because Babbage's design was decades ahead of his time. The Analytical Engine had input devices, arithmetical unit, control unit, memory, and output devices. In essence, the Analytical Engine was a computer, and thus gives Babbage the distinct honor of being named "Father of Computing."

   E. Hollerith tabulator--designed by Herman Hollerith to assist the United States census of 1890. Using cardboard about the size of a dollar bill, Hollerith devised a method for punching holes in the cardboard which in turn could be counted by his tabulating machine. This cut the census time down from years to weeks. Later, between 1910 and 1920, Hollerith is credited as one of the original founders of International Business Machines (IBM).

   F. Electronic Numerical Integrator and Calculator (ENIAC)--
   designed by the Moore School of Electrical Engineering in Pennsylvania in the years 1945-1946. ENIAC is credited with being the first known

electronic computer. ENIAC was much like modern computers in every way except one--no stored program. ENIAC was used to calculate ballistics tables and weather forecasts. Primary design is credited to Dr. John Mauchly and J. Presper Eckert.

G. Stored program concept--an idea developed by Johann von Neumann in the late 1940's. The stored program concept would allow computer programs to be stored within the computer's memory. This would allow the programmer to take advantage of the computer's processing speed, as well as allowing programs within the computer system to interact with each other.

H. Transistor--considered by most to be the most important single invention within the whole complex of inventions which we today call the computer. Replaced the electron tubes (valves) as the primary electronic component in computers. This provided smaller, lighter, faster, and more efficient computers. The design is credited to Bell Laboratories, 1948, under the direction of three American scientists, John Bardeen, Walter Houser Brattain, and William Bradford Shockley.

I. Integrated circuit--developed during the 1960's, integrated circuits allowed for the development of the microprocessor, or a single chip computer. Hundreds, thousands, and now millions of transistors can be placed on a chip about the size of a dime making possible a computer of greater size and complexity than ENIAC fitting in the palm of your hand.

2. Define the following contemporary computing terms/concepts and discuss their impact on society.

A. Artificial intelligence (AI)--doing on computers that which, if done by humans, would be called intelligent. The main impact on society is that the programs and systems relate to their users unlike any system before. Machines may develop the ability to understand; increasing their knowledge through intuitive reasoning. This places the computer/machine on an almost human level, being able to work through the fuzzy circumstances of life. Circumstances which are neither black nor white, but require an almost intuitive sense to reach a workable solution.

B. Expert systems--intelligent computer programs that use knowledge and inference procedures to solve problems that are difficult enough to require significant human expertise for their solution.

The knowledge necessary to perform at such a level, plus the inference procedures used, can be thought of as a model of the expertise of the best practitioners of the field (Feigenbaum). The greatest impact expert systems will have on society seem to be in the areas of construction, manufacturing, medicine, weapon systems, and image analysis and interpretation.

C. Computer-integrated manufacturing (CIM)--envisioned as taking computer-aided design/computer-aided manufacturing (CAD/CAM) one step further. In this approach, the design information obtained from CAD is used to control machine tool directly through CAM, without the need for human intervention. In addition, the robots are considered to be part of the CIM system and operate with other equipment in an integrated way to produce parts and complete assemblies (Critchlow). In the future, we may see entire assembly processes take place without the need for workers in the assembly area. Human interface would take place via multiprocessing, expert systems, which would be remotely connected as parallel processors in the CAD/CAM environment.

D. Fifth generation computing--computer machines which will be able to understand natural language and speech, interpret the visual world, tap large knowledge bases, and solve problems by deductive and inductive inference. The societal impact is not completely clear yet. However, it is apparent that one day machines/computers may have to be certified "human-like" before they will be allowed to function in their predestined vocation. "Droids" may become a reality.

E. Parallel processing--the form of multiprocessing that takes place when multiple processors cooperate closely to process tasks from the same job. Parallel processors can collectively process multiple instruction streams on multiple data streams (MIMD). Societal impact may be seen in such projects as Space Station, satellite communications, artificial intelligence (AI), and expert systems.

UNIT II TEST

I. Matching

Directions: Match the numbered item on the left with the lettered statement on the right. Place your correct answer in the blank space immediately to the left of the numbered item.

_____	1. Abacus	a.	Babbage's truly programmable computer
_____	2. Pascaline	b.	tabulating machine invented to assist in the 1890 census
_____	3. Difference Engine	c.	most important invention in computing technology
_____	4. Analytical Engine	d.	led the way to the development of the microprocessor
_____	5. Hollerith tabulator	e.	special purpose calculator designed by Babbage
_____	6. ENIAC	f	a collection of beads forming the first known computational device
_____	7. Stored program	g.	von Neumann
_____	8. Transistor	h.	first known electronic computer
_____	9. Integrated circuit	i.	first calculating machine

II. Discussion

Directions: Select one of the following future trends in computing technology, describe the trend, and give a brief discussion of its impact on society.

1. Artificial intelligence

2. Expert systems

3. Computer integrated manufacturing (CIM)

4. Fifth generation computing

5. Parallel processing

KEY TO UNIT II TEST

I. Matching

1. F
2. I
3. E
4. A
5. B
6. H
7. G
8. C
9. D

II. Discussion

1. Artificial intelligence (AI)--doing on computers that which, if done by humans, would be called intelligent. The main impact on society is that the programs and systems relate to their users unlike any system before. Machines develop the ability to understand; increasing their knowledge through intuitive reasoning. This places the computer/machine on an almost human level, being able to work through the fuzzy circumstances of life. Circumstances which are neither black nor white, but require an almost intuitive sense to reach a workable solution.
2. Expert systems--intelligent computer programs that use knowledge and inference procedures to solve problems that are difficult enough to require significant human expertise for their solution. The knowledge necessary to perform at such a level, plus the inference procedures used, can be thought of as a model of the expertise of the best practitioners of the field (Feigenbaum). The greatest impact expert systems will have on society seem to be in the areas of construction, manufacturing, medicine, weapon systems, and image analysis and interpretation.
3. Computer-integrated manufacturing (CIM)--envisioned as taking computer-aided design/computer-aided manufacturing (CAD/CAM) one step further. In this approach, the design information obtained from CAD is used to control machine tools directly through CAM, without the need for human intervention. In addition, the robots are considered to be part of the CIM system and operate with other equipment in an integrated way to produce parts and complete assemblies (Critchlow). In the future, we may see entire assembly processes take place without the need for workers in the assembly area. Human interface would take place via multiprocessing, expert systems, which would be remotely connected as parallel processors in the CAD/CAM environment.

4. Fifth generation computing--computing machines which will be able to understand natural language and speech, interpret the visual world, tap large knowledge bases, and solve problems by deductive and inductive inference. The societal impact is not completely clear yet. However, it is apparent that one day machines/computers may have to be certified "human-like" before they will be allowed to function in their predestined vocation. "Droids" may become a reality.
5. Parallel processing--the form of multiprocessing that takes place when multiple processors cooperate closely to process tasks from the same job. Parallel processors can collectively process multiple instruction streams on multiple data streams (MIMD). Societal impact may be seen in such projects as Space Station, satellite communications, artificial intelligence (AI), and expert systems.

EVALUATION AND TESTING

Students will be evaluated by the following guidelines:

1. Complete unit test with at least 70 percent accuracy.
2. Complete research assignments with acceptable minimum performance as determined by the instructor.
3. Demonstrate ability to read and comprehend.
4. Demonstrate ability to identify meaning of unknown words or common terms.
5. Demonstrate resourcefulness in locating information.
6. Demonstrate ability to record outline notes that provide accurate and complete information needed for future use.
7. Actively participate in class discussions.

EQUIPMENT AND SUPPLIES

1. Reference material as listed in references, and
2. Overhead projector and transparency materials.

BULLETIN BOARD IDEAS

Scan through newspapers and current periodicals for newsworthy topics related to the unit outline. Pictures of early computing devices, as well as contemporary technology should be placed attractively on the bulletin board. Use the bulletin board as a teaching aid, thus increasing student awareness of related topics.

SUPPLEMENTARY MATERIALS

SELECTED BIBLIOGRAPHY

Aleksander, Igor. Designing Intelligent Systems, An Introduction. New Technology Modular Series. New York: Unipub, 1984.

Critchlow, Arthur J. Introduction to Robotics. New York: Macmillan Publishing Company, 1985.

Evans, Christopher. The Making of the Micro, A History of the Computer. Forward by Tom Stonier. New York: Van Nostrand Reinhold Company, 1981.

Johnston, Rory, and Michie, Donald. The Knowledge Machine, Artificial Intelligence and the Future of Man. New York: William Morrow and Company, Inc., 1985.

Shurkin, Joel. Engines of the Mind, A History of the Computer. New York: W. W. Norton and Company, 1984.

U. S. Department of Commerce. National Bureau of Standards. An Overview of Expert Systems, by William B. Gevarter, prepared for National Aeronautics and Space Administration Headquarters, publication number NBSIR 82-2505. Washington, D. C.: Government Printing Office, May 1982.

PERIODICALS CONSULTED

Byte, The Small Systems Journal. Vol. 10, No. 4, April, 1985.

Byte, The Small Systems Journal. Vol. 11, No. 1, January, 1986.

Communications of the ACM. Volume 28, Number 11, November, 1985.

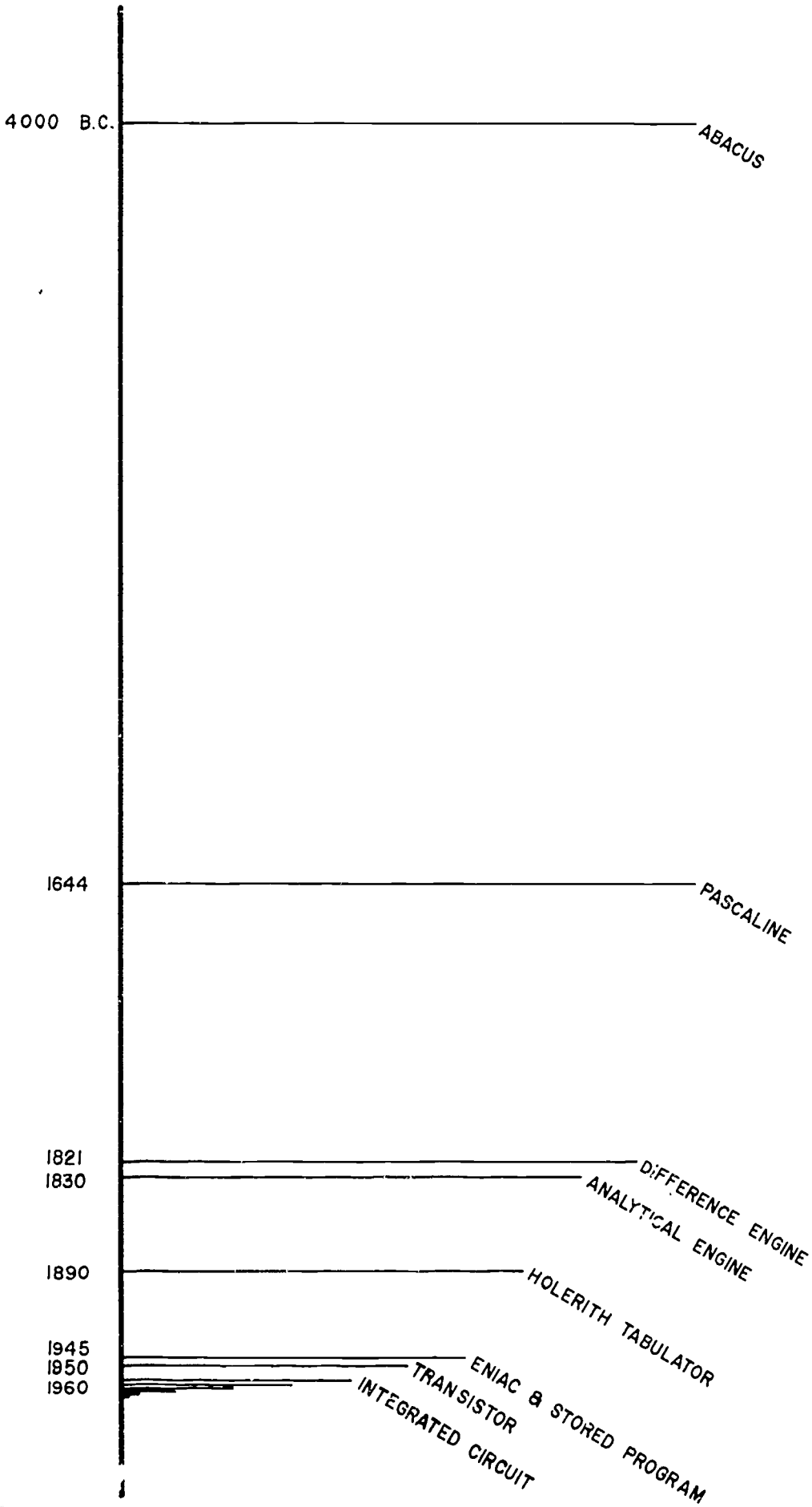
Computer, IEEE Computer Society. Volume 18, Number 6, June, 1985

Robotics World, A Publication of Communication Channels, Inc. Volume 4, Number 3, March 1986.

OVERHEAD TRANSPARENCIES

History of Computing Developments Time Line

DEVELOPMENT OF COMPUTING TECHNOLOGY TIME LINE



UNIT III

DIGITAL ELECTRONICS

INTRODUCTION

Thanks to the integrated circuit, digital electronics has moved to the forefront in computer technology. No longer are we bound by the size limitation of discrete component digital logic, but rather we have moved into the era of multiple thousands, even millions of digital circuits located on a single integrated circuit.

The student who wishes to be a participant in today's and tomorrow's technology must master the fundamentals of digital logic. Digital logic is the foundation needed for an understanding of microprocessors. The purpose of this unit will be to enable each student to master the fundamentals of digital electronics.

COMPETENCIES

1. Convert from one number base to another.
2. Master the basic logic functions.
3. Distinguish between combinational and sequential digital circuits.
4. Understand the use of digital test equipment.

GENERAL PERFORMANCE OBJECTIVES/GOALS

1. Develop skills in converting between number bases.
2. Develop skills in identifying logic gates and properly constructing truth tables for each logic function.
3. Identify digital circuits as either combinational or sequential.
4. Develop skills in the selection and use of digital test equipment.

SPECIFIC PERFORMANCE OBJECTIVES AND MASTERY CRITERIA

1.1 On a written examination, students will demonstrate their ability to convert between the following number bases: decimal, binary, octal, and hexadecimal.

2.1 On a written examination, students will demonstrate their ability to correctly identify the following logic functions: AND, OR, NOT, NOR, and NAND.

2.2 On a written examination, students will demonstrate their ability to correctly construct truth tables for the following logic functions: AND, OR, NOT, NAND, and NOR.

3.1 On a written examination, students will correctly define combinational and sequential logic circuits.

3.2 On a written examination, students will correctly identify digital circuits as either combinational or sequential.

4.1 On a written examination, students will select the proper test equipment for use in digital circuits.

METHODOLOGY

The instructor should develop a presentation for number base conversion. As a followup, practice problems should be constructed emphasizing those base conversions covered in the presentation. A lecture should be planned to present the basic logic functions; their proper symbolic representation and truth tables. Daily exams work well in evaluating AND, OR, and NOT identification and truth tables. Next, the instructor should prepare a lecture defining combinational and sequential logic circuits. Practice problems in identification of sequential and/or combinational circuits may be used as reinforcement. Finally, demonstrate the proper use of digital test equipment, for example a logic probe and/or digital multimeter. If time permits, allow each student practice in using the digital test equipment.

Remember, it is essential for the student to master the logic functions, that is a thorough understanding, if he/she is to understand the inner workings of a microprocessor.

SUGGESTED INTEREST APPROACHES

1. Provide students with practice problems in number base conversion.

2. Use daily examinations to provide the necessary motivation to keep current.

3. Outline the basic logic functions using the "Logic Functions" overhead.

4. Provide the students with practice problems in the identification of logic functions.

5. Use the "Combinational and Sequential Circuits" overhead to explain the difference between combinational and sequential logic circuits.

6. Demonstrate the proper use of digital test equipment. Also, if time permits, allow the students to use the digital test equipment to take sample readings.

UNIT III OUTLINE

DIGITAL ELECTRONICS

I. Number systems

- A. Number bases 2, 8, 10, and 16
- B. Conversion between bases

II. Basic logic functions

- A. AND
- B. OR
- C. NOT
- D. NAND
- E. NOR

III. Digital circuits

- A. Combinational
- B. Sequential

IV. Digital test equipment

- A. Logic probe
- B. Digital multimeter

SPECIFIC PERFORMANCE OBJECTIVES

1.1 On a written examination, students will demonstrate their ability to convert between the following number bases: decimal, binary, octal and hexidecimal.

Subject Matter Content	Learning Activities
Conversion between numbers bases	1. Demonstrate the correct techniques needed for the student to successfully convert between number bases. 2. Practice problems should be assigned in order for the student to perfect conversion techniques.

2.1 On a written examination, students will demonstrate their ability to correctly identify and label the following logic functions: AND, OR, NOT, NOR, and NAND.

Subject Matter Content	Learning Activities
AND, OR, NOT, NAND, and NOR logic functions	1. Draw on the board the correct logic function symbols. 2. Practice sheets should be constructed which would allow the student the opportunity to correctly identify logic functions. 3. A summarizing lecture should be planned emphasizing the importance of the logic functions.

2.2 On a written examination, students will demonstrate their ability to correctly construct truth tables for the following logic functions: AND, OR, NOT, NAND, and NOR.

Subject Matter Content	Learning Activities
AND, OR, NOT, NAND, and NOR truth tables	1. Draw on the board the truth tables for the AND, OR, NOT, NAND, and NOR logic functions. 2. Provide practice problems for the students covering the five logic functions.

3.1 On a written examination, students will correctly define combination and sequential logic circuits.

Subject Matter Content	Learning Activities
Combinational and sequential logic circuits	1. Plan a lecture defining combinational and sequential logic circuits. 2. Using simple combinational and sequential circuits demonstrate the difference between the two.

3.2 On a written examination, students will correctly identify digital circuits as either combinational or sequential.

Subject Matter Content	Learning Activities
Combinational and sequential logic circuits	1. Describe the difference between combinational and sequential logic circuits.

	2. Using practice circuits, provide the students the opportunity to correctly identify both combinational and sequential circuits.

4.1 On a written examination, students will select the proper test equipment for making the correct measurements.

Subject Matter Content	Learning Activities
Use of digital test equipment	1. Demonstrate to the students the proper use of digital test equipment. 2. Provide an opportunity for the students to use digital test equipment in making measurements.

ACTIVITY SHEET

Number Systems

1. Draw a number power line for decimal, binary, octal, and hexadecimal.

2. Construct a binary chart for octal and hexadecimal.

3. Convert between the following bases:

   A. Decimal to binary

      1) 8_{10} _____ $_2$

      2) 15_{10} _____ $_2$

      3) 37_{10} _____ $_2$

      4) 128_{10} _____ $_2$

      5) 244_{10} _____ $_2$

   B. Decimal to octal

      1) 5_{10} _____ $_8$

      2) 9_{10} _____ $_8$

      3) 28_{10} _____ $_8$

      4) 127_{10} _____ $_8$

      5) 239_{10} _____ $_8$

   C. Decimal to hexadecimal

      1) 5_{10} _____ $_{16}$

      2) 9_{10} _____ $_{16}$

      3) 28_{10} _____ $_{16}$

      4) 127_{10} _____ $_{16}$

      5) 255_{10} _____ $_{16}$

D. Binary to decimal

1) 1000_2 _____ $_{10}$

2 1111_2 _____ $_{10}$

3) 100101_2 _____ $_{10}$

4) 10000000_2 _____ $_{10}$

5) 11110100_2 _____ $_{10}$

E. Octal to decimal

1) 5_8 _____ $_{10}$

2) 11_8 _____ $_{10}$

3) 34_8 _____ $_{10}$

4) 177_8 _____ $_{10}$

5) 357_8 _____ $_{10}$

F. Hexadecimal to decimal

1) 5_{16} _____ $_{10}$

2) 9_{16} _____ $_{10}$

3) $1B_{16}$ _____ $_{10}$

4) $7F_{16}$ _____ $_{10}$

5) FF_{16} _____ $_{10}$

G. Binary to hexadecimal and octal

1) 1110_2 _____ $_{16}$

2) 101000_2 _____ $_{8}$

3) 01001010_2 _____ $_{16}$

4) 01011010_2 _____ $_{8}$

H. Hexadecimal and octal to binary

1) FE_{16} _____ 2

2) 376_8 _____ 2

ACTIVITY SHEET KEY

Number Systems

1. DECIMAL NUMBER POWER LINE

10^5	10^4	10^3	10^2	10^1	10^0
100,000	10,000	1,000	100	10	1

BINARY NUMBER POWER LINE

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

OCTAL NUMBER POWER LINE

8^5	8^4	8^3	8^2	8^1	8^0
32,768	4,096	512	64	8	1

HEXADECIMAL NUMBER POWER LINE

16^4	16^3	16^2	16^1	16^0
65,536	4,096	256	16	1

2. BINARY TO OCTAL CHART

binary	octal
0 0 0	0
0 0 1	1
0 1 0	2
0 1 1	3
1 0 0	4
1 0 1	5
1 1 0	6
1 1 1	7

binary to hexadecimal chart

binary	hex
0 0 0 0	0
0 0 0 1	1
0 0 1 0	2
0 0 1 1	3
0 1 0 0	4
0 1 0 1	5
0 1 1 0	6
0 1 1 1	7
1 0 0 0	8
1 0 0 1	9
1 0 1 0	A
1 0 1 1	B
1 1 0 0	C
1 1 0 1	D
1 1 1 0	L
1 1 1 1	F

Number Systems (cont)

3. A. (1) 1000, (2) 1111, (3) 10 0101, (4) 1000 0000, (5) 1111 0100
   B. (1) 5, (2) 11, (3) 34, (4) 177, (5) 357
   C. (1) 5, (2) 9, (3) 1B, (4) 7F, (5) FF
   D. (1) 8, (2) 15, (3) 37, (4) 128, (5) 244
   E. (1) 5, (2) 9, (3) 28, (4) 127, (5) 239
   F. (1) 5, (2) 9, (3) 28, (4) 127, (5) 255
   G. (1) E, (2) 50, (3) 4A, (4) 112
   H. (1) 1111 1110, (2) 011 111 110

ACTIVITY SHEET

Logic Functions

1. Draw the correct symbolic representation ABOVE the logic function name. Use the input letters 'A' and 'B' where applicable.

AND OR NOT

NAND NOR

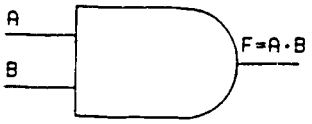
2. For each logic symbol in question 1 (one), draw the correct truth table BELOW the logic name. Use a two set, A and B, binary universe.

AND OR NOT

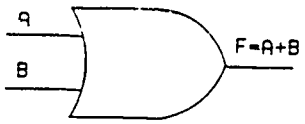
NAND NOR

Logic Functions

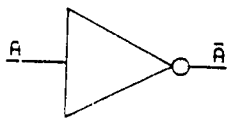
1. Draw the correct symbolic representation above the logic function name. Use the input letters 'A' and 'B' where applicable.



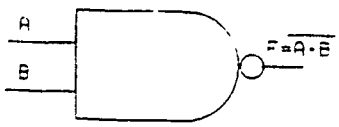
AND



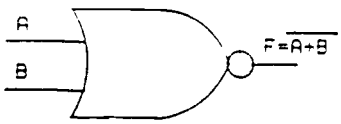
OR



NOT



NAND



NOR

2. For each logic symbol in question 1 (one), draw the correct truth table BELOW the logic name. Use a two set, A and B, binary universe.

AND

A · B	F=AB
0 0	0
0 1	0
1 0	0
1 1	1

OR

A + B	F=A+B
0 0	0
0 1	1
1 0	1
1 1	1

NOT

A	$\bar{A}$
0	1
1	0

NAND

A · B	$F=\overline{AB}$
0 0	1
0 1	1
1 0	1
1 1	0

NOR

A + B	$F=\overline{A+B}$
0 0	1
0 1	0
1 0	0
1 1	0

ACTIVITY SHEET (cont)

Combinational and Sequential Logic Circuits

1. Define:

   a. combinational logic circuits --

   b. sequential logic circuits --

2. Identify the following as either combinational or sequential logic circuits:

   a. exclusive or _____

   b. AND gate _____

   c. S R flipflop _____

ACTIVITY SHEET KEY

Combinational and Sequential Logic Circuits

1. Define:

   a. combinational logic circuits-- those digital circuits whose output at any given time are dependent only on the inputs at that time.

   b. sequential logic circuits-- circuits that have outputs that depend not only on the present inputs but also on some memory of past inputs.

2. Identify the following as either combinational or sequential logic circuits:

   a. exclusive or ___combinational___

   b. AND gate ___combinational___

   c. S R flipflop ___sequential___

ACTIVITY SHEET

Use of test equipment

Using a digital electronic trainer, properly configure an AND gate for operation. Use available digital test equipment in determining the validity of the truth table for the AND operation.

NOTE: No key is provided. The instructor should consult the operation manual and experiment's packet for the digital trainer selected. The students should be under the direct supervision of the instructor during test equipment operation.

UNIT III TEST

I. Number bases

Directions: Correctly convert from the given base to the asked for base. Place the correct answer in the blank space to the right of the given number.

A. 79_{10} _____ 2

B. 10011010_2 _____ 10

C. 10_{10} _____ 8

D. 43_8 _____ 10

E. 64_{10} _____ 16

F. $7E_{16}$ _____ 10

II. Logic functions

Directions: In part A, correctly draw the symbols for the following logic functions ABOVE the logic function name. In part B, correctly construct the truth tables for the logic functions in A. Construct the tables BELOW the logic function word.

A.

AND OR NOT

NAND NOR

B.

AND OR NOT

II. B (cont)

NAND NOR

III. Combinational and sequential logic circuits

Directions: Correctly define combinational and sequential logic circuits in the space to the right and below of each term.

A. Combinational logic circuits --

b. Sequential logic circuits --

IV. Use of digital test equipment

Directions: Write the word, digital or analog, which best describes the use of the following test equipment in the blank space immediately to the right of the indicated test equipment. If the test equipment could be used equally well in both applications write both words.

A. oscilloscope _____

B. digital multimeter _____

C. analog multimeter _____

D. logic analyzer _____

E. logic probe _____

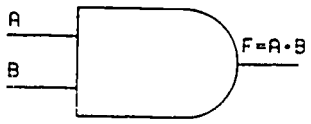
UNIT III TEST KEY

I. Number bases

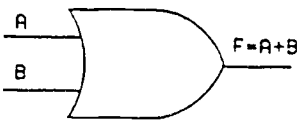
A. 0100 1111; B. 154; C. 12; D. 35; E. 40; F. 126

II. Logic functions

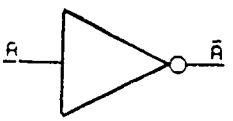
A.



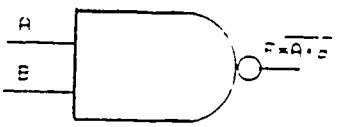
AND



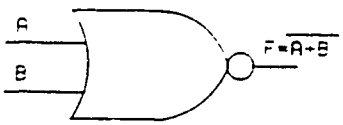
OR



NOT



NAND



NOR

B.

AND

A	B	F=AB
0	0	0
0	1	0
1	0	0
1	1	1

OR

A	B	F=A+B
0	0	0
0	1	1
1	0	1
1	1	1

NOT

A	$\bar{A}$
0	1
1	0

NAND

A	B	$F=\overline{AB}$
0	0	1
0	1	1
1	0	1
1	1	0

NOR

A	B	$F=\overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

III. Combinational and sequential logic circuits

A. combinational logic circuits-- those digital circuits whose output at any given time are dependent only on the inputs at that time.
B. sequential logic circuits-- circuits that have outputs that depend not only on the present inputs but also on some memory of past inputs.

IV. Use of digital test equipment

A. digital and analog; B. digital and analog; C. analog; D. digital; E. digital

EVALUATION AND TESTING

Students will be evaluated by the following guidelines:

1. Complete unit test with at least 70 percent accuracy.
2. Complete research assignments with acceptable minimum performance as determined by the instructor.
3. Demonstrate the ability to read and comprehend.
4. Demonstrate the ability to identify meaning of unknown words or common terms.
5. Demonstrate the resourcefulness in locating information.
6. Demonstrate the ability to record outline notes that provide accurate and complete information needed for future use.
8. Actively participate in class discussions.

EQUIPMENT AND SUPPLIES

Equipment

1. Digital trainer[1]
2. Digital test equipment to possibly include a digital multimeter, logic probe, and oscilloscope
3. Overhead projector and transparency materials

Notes:

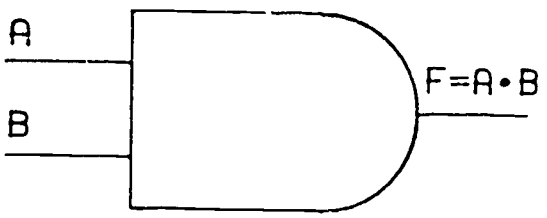
[1]Whichever digital trainer is selected, it should include the capabilities of AND, OR, NOT, NAND, NOR, EOR(XOR), and SR FLIPFLOPS.
Such trainers are manufactured by Heath Company, Hickock, Digiac, E and L Instruments, Broadhead Garrett, and Lab-Volt. These are but a few of the companies and should not be misconstrued as the only companies which manufacture such digital training equipment.

BULLETIN BOARD IDEAS

Digital logic gate symbols can be cut from construction paper and attractively placed on the bulletin board. Pictures of everyday appliances which use digital circuitry (T.V., stereo, CD players) may be placed on the bulletin board to stimulate student interest.

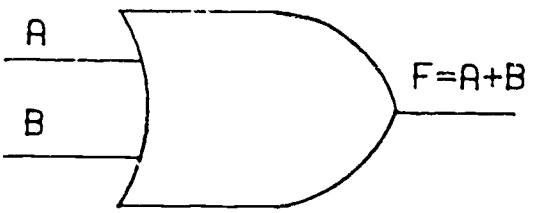
LOGIC FUNCTIONS

AND



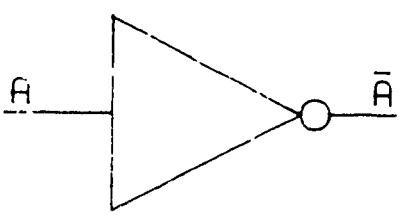
A • B F=A•B

OR



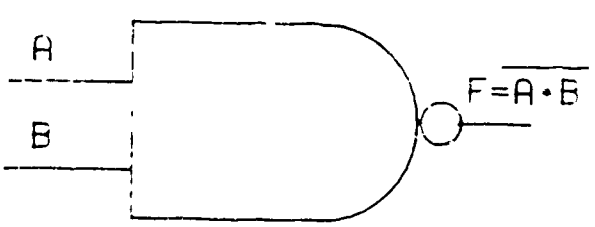
A + B F=A+B

NOT



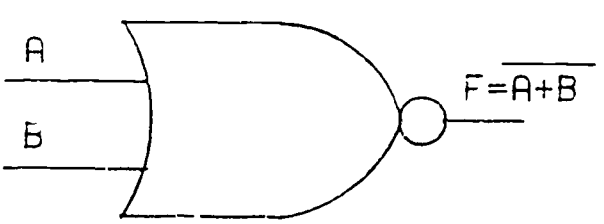
A $\bar{A}$

NAND



A • B $F=\overline{A \cdot B}$

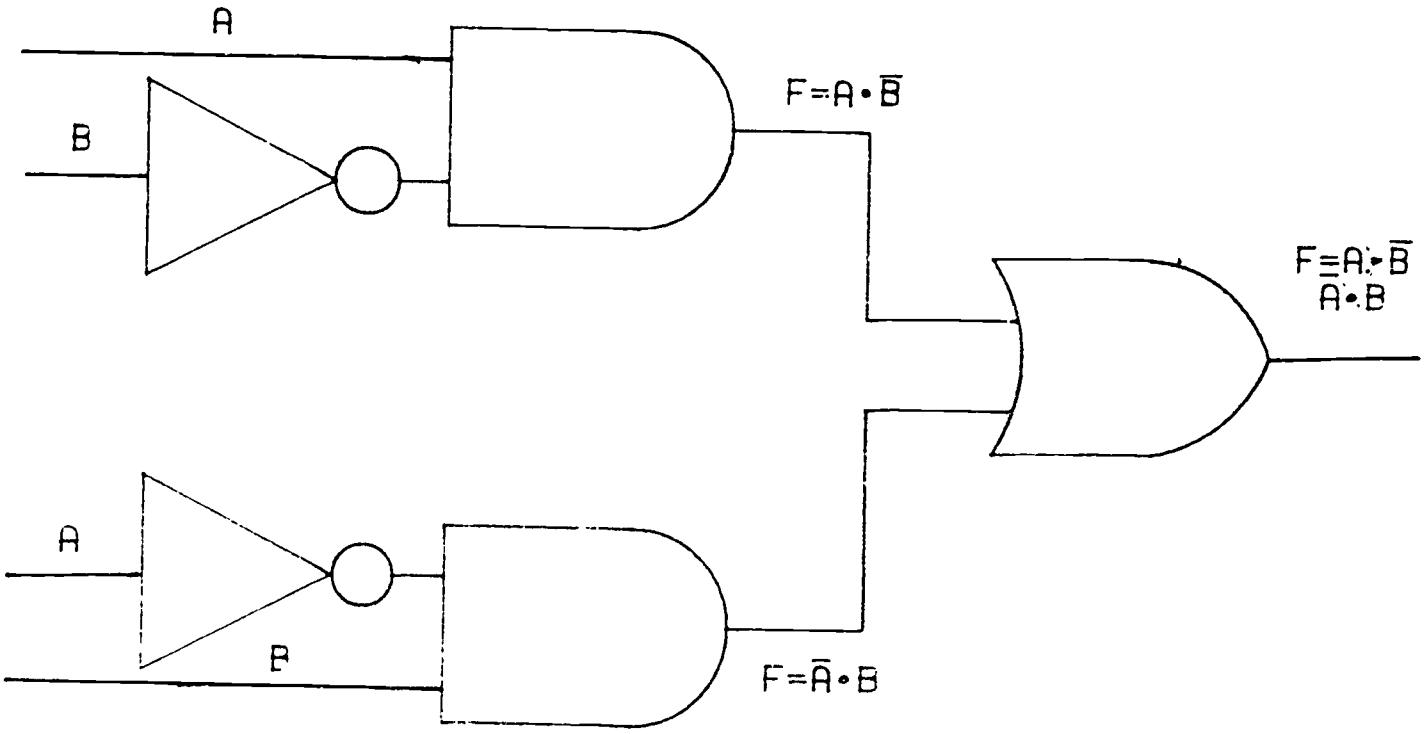
NOR



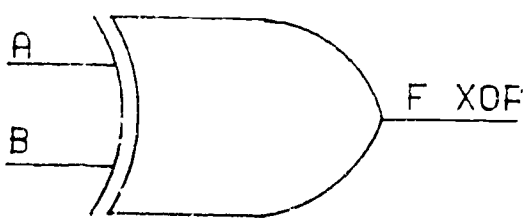
A + B $F=\overline{A+B}$

COMBINATIONAL AND SEQUENTIAL LOGIC CIRCUITS

COMBINATIONAL EXCLUSIVE OR (XOR, EOR)

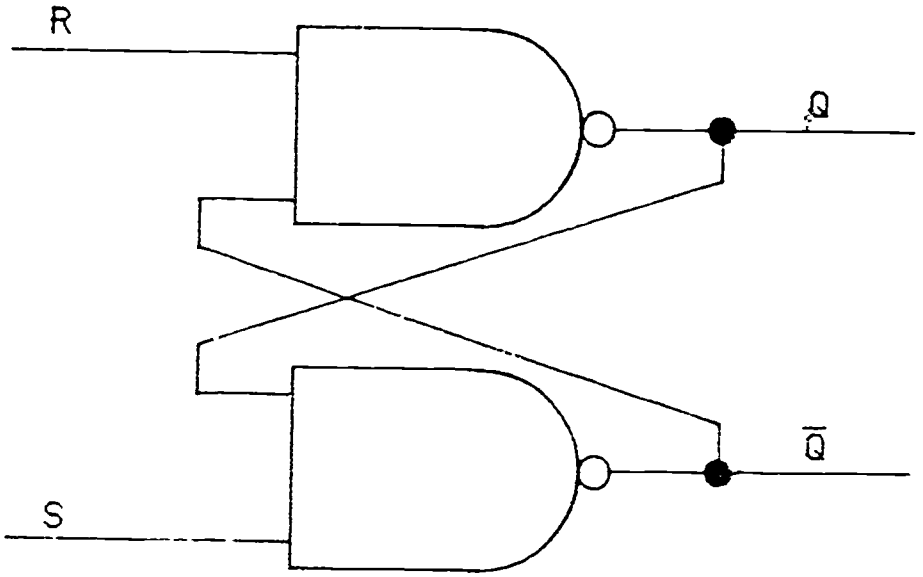


POINTS	AB	$\bar{B}$	$A\cdot\bar{B}$	$\bar{A}$	$\bar{A}\cdot B$	$F=A\cdot\bar{B}+\bar{A}\cdot B$
0	00	1	0	1	0	0
1	01	0	0	1	1	1
2	10	1	1	0	0	1
3	11	0	0	0	0	0



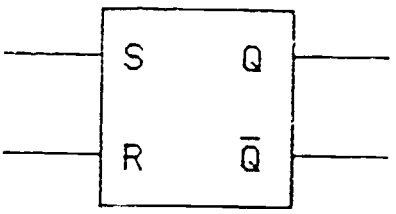
COMBINATIONAL AND SEQUENTIAL LOGIC CIRCUITS

SEQUENTIAL SR FLIP-FLOP



S	R	F @ Q
0	0	NOT ALLOWED
0	1	0
1	0	1
1	1	Q (NO CHANGE)

ABBREVIATED SYMBOL FOR SR FLIP-FLOP



SUPPLEMENTARY MATERIALS

SELECTED BIBLIOGRAPHY

Cowan, Sam. Handbook of Digital Logic, with Practical Applications. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1985.

Digital Electronics, Unit IV. Natchitoches, Louisiana: Vocational Curriculum Development and Research Center, 1985.

Digital Techniques. Benton Harbor, Michigan: Heath Company, 1975.

Leach, Donald P., and Malvino, Albert Paul. Digital Principles and Applications. New York: McGraw-Hill Book Company, 1981.

McKay, Charles W. Digital Circuits, A Preparation for Microprocessors. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1978.

Nice, James W. A Lab Manual for Putman's Digital Electronics, Theory, Applications and Troubleshooting. Englewood Cliffs, New Jeresy: Prentice-Hall, Inc., 1978.

Putman, Byron W. Digital and Microprocessor Electronics: Theory, Applications, and Troubleshooting. Englewood Cliffs, New Jersey: Prentice-Hall, 1986.

Putman, Byron W. Digital Electronics, Theory, Applications and Toubleshooting. Englewood Cliffs, New Jersey: Prentice-Hall, 1986.

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OVERHEAD TRANSPARENCIES

Logic Functions
Combinational and Sequential Logic Circuits

UNIT IV

MICROPROCESSORS

INTRODUCTION

The advent of the microprocessor has introduced the whole of our society to the computer age. Ten years ago it would have been beyond most of our imaginations to have envisioned computers controlling virtually every facet of the automobile, yet that is a reality. Furthermore, the idea that a home computer would be within financial reach of most American families would have been foolishness to us, yet that too is a reality. Microprocessors have invaded every aspect of daily life. Nothing is sacred to the control of the micro. From artificial hearts to artificial limbs, from sight to speech and hearing, from music to washing dishes, and from automobiles to stereos; the modern family is not exempt from a knowledge of the microprocessor. Granted, the average user of such familiar devices does not need to know how to program the microprocessor in order to benefit from it, but he/she does need to be cognizant of what the microprocessor is doing if an appreciation of the importance the microprocessor plays in our society is to be realized.

As a result of the enormity of the impact the microprocessor has had and will continue to have on society we will lay the ground work for a basic understanding of the microprocessor. Our purpose is to provide a framework for further study by introducing the student to the fundamental concepts of the microprocessor.

COMPETENCIES

1. Understand the basic architecture of a hypothetical microprocessor.
2. Write a simple program to control the operation of the microprocessor.
3. Understand the structure of basic memory systems available to the microprocessor.

GENERAL PERFORMANCE OBJECTIVES/GOALS

1. Label and define the function of the principle architectural components of our hypothetical microprocessor.
2. Using immediate, direct, and indirect addressing modes, structure a program which will control the operation of the microprocessor.
3. Define the memory systems commonly used within the microprocessor environment.

SPECIFIC PERFORMANCE OBJECTIVES AND MASTERY CRITERIA

1.1 On a written examination, students will demonstrate their knowledge of the Harvard class and von Neumann class microprocessors by distinguishing between the two.

1.2 On a written examination, students will demonstrate their knowledge of the architecture of the hypothetical microprocessor by correctly labeling the functional components of that architecture.

1.3 On a written examination, students will demonstrate their knowledge of the functional components of the hypothetical microprocessor by matching the component with the correct description of that component.

2.1 On a written examination, students will write a program which will incorporate inherent, immediate, and direct addressing modes in the control of the microprocessor.

3.1 On a written examination, students will describe and discuss the advantages and disadvantages of RAM, ROM, PROM, and EPROM memory systems.

METHODOLOGY

The instructor should structure a lecture to identify and define the components of our hypothetical microprocessor. This lecture should be followed with student activity sheets which reinforce the lecture materials. Depending upon which microprocessor trainer the instructor has access to, a lecture should now be planned to tie in the hypothetical microprocessor and the trainer to be used in the laboratory exercises. Activity sheets which reinforce lecture material will stimulate student interest.

Programming the microprocessor is appropriately taught using definition, observation, and experimentation techniques. Again, each microprocessor trainer will have suggested student activities which will not only reinforce new concepts but will arouse student interest. The student's active participation through completion of programming exercises will prove to be the catalyst to understand and problem solve microprocessors.

A summarizing lecture should be planned with emphasis upon the microprocessor and memory systems. Demonstration through the use of the available microprocessor trainer will reinforce student observations, thus providing the necessary link between theory and reality.

SUGGESTED INTEREST APPROACHES

1. Provide students activity sheets which will require application of lecture material in linking together those similar concepts from the hypothetical microprocessor and the microprocessor used in the laboratory trainer.
2. Daily examinations assist in maintaining student motivation.
3. Demonstrative examples showing the microprocessor's elementary instruction set.
4. Practice programming problems, concentrating on addressing modes to foster student comprehension.
5. Demonstrate techniques used to interface peripheral memory to the microprocessor.
6. A summarizing lecture will imbue the students with the desire to continue their study of microprocessors.

UNIT IV OUTLINE

MICROPROCESSORS

I. Hypothetical eight bit microprocessor

- A. Harvard class
  1. Input medium
  2. Memory
  3. Calculating section
  4. Decision capability
  5. Output medium
- B. Prince or von Neumann class -- stored program
- C. Typical eight bit microprocessor
  1. Arithmetic/logic unit (ALU)
  2. Control logic unit (CLU)
  3. Instruction decoder
  4. Accumulator (AC or ACC)
  5. Memory data register (MDR)
  6. Memory data bus
  7. Memory address register (MAR)
  8. Memory address bus
  9. Input/output bus
  10. Program counter (PC)
  11. Stack
  12. Scratch pad memory
  13. Instruction register
  14. Status register
- D. Motorola MC6800, Zilog Z80, Intel 8085

II. Programming Basics

A. Inherent instructions
   1. Clear accumulator (CLRA)
   2. Wait for interrupt (WAI)
   3. Increment and decrement accumulator (INCA, DECA)

B. Immediate address instructions
   1. Load accumulator immediate (LDA)
   2. Add and subtract accumulator immediate (ADDA and SUBA)

C. Direct address instructions
   1. Load, add, and subtract accumulator direct (LDA, ADDA, SUBA)
   2. Store accumulator direct (STA)

D. Relative addressing (if time permits)

III. Memory systems

A. Read/write random access memory (RAM)
B. Read only memory (ROM)
C. Programmable read only memory (PROM)
D. Erasable programmable read only memory (EPROM)

SPECIFIC PERFORMANCE OBJECTIVES

1.1 On a written examination, students will demonstrate their knowledge of the Harvard class and von Neumann class microprocessors by distinguishing between the two.

Subject Matter Content	Learning Activities
Harvard and von Neumann class microprocessors	1. Prepare a lecture describing the differences between the Harvard and von Neumann classes of microprocessors. 2. Draw on the board the basic components for both the Harvard and von Neumann classes of microprocessors labeling each.

1.2 On a written examination, students will demonstrate their knowledge of the architecture of the hypothetical microprocessor by correctly labeling the functional components of that architecture.

Subject Matter Content	Learning Activities
Hypothetical microprocessor architectures	1. Using the overhead entitled, "Hypothetical Microprocessor Architecture", show and explain the components of the microprocessor. 2. Provide students handouts which can be completed as the lecture progresses. 3. Compare the microprocessor's operational characteristics to that of the human brain.

1.3 On a written examination, students will demonstrate their knowledge of the functional components of the hypothetical microprocessor by matching the component with the correct description of that component.

Subject Matter Content	Learning Activities
Microprocessor Components	1. Hand out the activity sheet associated with microprocessor components. Students should complete this during the lecture. 2. Use the block diagram overhead entitled "Hypothetical Microprocessor Architecture" in explaining the purpose of the functional components.

2.1 On a written examination, students will write a program which will incorporate inherent, immediate, and direct addressing modes in the control of the microprocessor.

Programming Basics	Learning Activities
Use of inherent, immediate, and direct addressing instructions	1. A class lecture should be used to develop each instruction. 2. As each instruction is developed via lecture, practice programming exercises should be incorporated solidifying microprocessor/instruction operation.

3.1 On a written examination, students will describe and discuss the advantages and disadvantages of RAM, ROM, PROM, and EPROM memory systems.

Subject Matter Content	Learning Activities
RAM, ROM, PROM, and EPROM memory	1. Define each type of memory system as outlined. 2. Using the microprocessor trainer available, demonstrate to the students how memory is interfaced with the trainer.

ACTIVITY SHEET

Directions: Using the manual which comes with your microprocessor trainer, identify and describe the following components of your architecture.

1. Arithmetic/logic unit (ALU) --

2. Control logic unit (CLU) --

3. Instruction decoder --

4. Accumulator (ACC or AC) --

5. Memory data register (MDR) --

6. Memory data bus --

7. Memory address register (MAR) --

8. Memory address bus --

9. Input/output bus --

10. Program counter (PC) --

11. Stack --

12. Scratch pad memory --

13. Status register --

ACTIVITY SHEET KEY

Directions: Using the manual which comes with your microprocessor trainer, identify and describe the following components of your architecture.

1. Arithmetic/logic unit (ALU) -- performs arithmetical and logical operations on data received from memory or input devices.

2. Control logic unit (CLU) -- controls the flow of data and instructions within the computer.

3. Instruction decoder -- after an instruction is fetched from memory and placed in the instruction register (IR), the instruction is decoded by this circuit. The instruction decoder examines the 8 bit data word and decides which operation is to be performed.

4. Instruction register (IR) -- contains he instruction which is being decoded and executed.

5. Accumulator (ACC or AC) -- one of the most useful registers in the microprocessor. During arithmetic or logic operations it holds the operand before the operation, and after the operation it holds the resulting sum, difference, or logical answer. Also, data can be fetched from memory and held there until operated upon.

6. Memory data register (MDR) -- temporary storage location for data going to or coming from memory.

7. Memory data bus -- the 8 bit "highway" on which data travels to and from memory.

8. Memory address register (MAR) -- temporary storage location which holds the address of the memory or input/output (I/O) device that is used in the operation currently being performed.

9. Memory address bus -- the 16 bit "highway" on which addresses of memory or I/O devices are opened and closed.

10. Input/output bus -- see "data bus".

11. Program counter (PC) -- controls the sequence in which the instructions in a program are performed. Actually, the PC contains the address in memory of the instruction which is being processed.

12. Stack -- an array of registers which allows words or addresses to be accessed from the top of this array on a last-in, first-out (LIFO) basis.

13. Scratch pad memory -- registers used by the microprocessor for temporary storage of data and addresses. The number and flexibility of these registers varies from microprocessor to microprocessor.

14. Status register -- provides an indication of overflow from operations, presence of zeros in the accumulator, sign of a number, and carry resulting from operations. These indicators are called flags.

ACTIVITY SHEET

Directions: Using the microprocessor trainer available to you, develop a program which will clear the accumulator, load the number 8 into the accumulator, add 7 to it, increment the accumulator by 1, and leave the results in the accumulator.

Step 1

Develop the flow chart or sequence structure for the addition problem.

Sequence Structure

Step 2

Write the program using the coding sheet for the microprocessor available to you.

ACTIVITY SHEET KEY

Directions: Using the microprocessor trainer available to you, develop a program which will clear the accumulator, load the number 8 into the accumulator, add 7 to it, increment the accumulator by 1, and leave the results in the accumulator.

Step 1

Develop the flow chart or sequence structure for the addition problem.

Sequence Structure

```
BEGIN
:     CLEAR THE ACC;
:     LOAD ACC WITH 08 IMMEDIATE;
:     ADD 07 TO ACC IMMEDIATE;
:     INCREMENT ACC;
END
```

Step 2

Write the program using the coding sheet for the microprocessor available to you. (MC6800 used only as example, actual code for your microprocessor may differ)

MC6800 code

```
CLRA                    ;CLEAR ACCUMULATOR
LDAA      #08           ;LOAD 8 INTO ACC
                (IMMEDIATE)
ADDA      #07           ,ADD 7 TO 8 (IMMEDIATE)
INCA                    ;ADD 1 TO ACC
WAI                     ;END OF PROGRAM (INHERENT)
```

Machine code

addr	code
0000	4F
0001	86
0002	08
0003	8B
0004	07
0005	4C
0006	3E

ACTIVITY SHEET

Directions: Using the microprocessor trainer available to you, develop a program which will load the accumulator with the hexadecimal number F from memory location 001A, subtract the hexadecimal number B stored in memory location 001B, and store the difference in memory location 001C.

Step 1

Develop the flow chart or sequence structure

Sequence Structure

Step 2

Write the program using the coding sheet for the microprocessor available to you. (MC6800 used on as example, actual code for your microprocessor may differ)

ACTIVITY SHEET KEY

Directions: Using the microprocessor trainer available to you, develop a program which will load the accumulator with the hexadecimal number F from memory location 001A, subtract the hexadecimal number B stored in memory location 001B, and store the difference in memory location 001C.

Step 1

Develop the flow chart or sequence structure

Sequence Structure

```
BEGIN
:     LOAD ACC DIRECT WITH 0F;
:     SUBTRACT DIRECT 0B FROM ACC;
:     STORE DIRECT DIFFERENCE AT 001C;
END
```

Step 2

Write the program using the coding sheet for the microprocessor available to you. (MC6800 used on as example, actual code for your microprocessor may differ)

MC6800 code

```
LDAA      $1A
SUBA      $1B
STAA      $1C
WAI
```

Machine Code

addr	code
0000	96
0001	1A
0002	90
0003	1B
0004	97
0005	1C
0006	3E

ACTIVITY SHEET

Directions: Using the microprocessor trainer available to you, develop a program which will clear the accumulator, load the accumulator with the hexadecimal number 2E, add hexadecimal number 12 stored at memory location 0010, store the sum at memory location 0011 and clear the accumulator.

Step 1

Develop the flow chart or sequence structure

Sequence Structure

Step 2

Write the program using the coding sheet for the microprocessor available to you. (MC6800 used only as example, actual code for your microprocessor may differ)

ACTIVITY SHEET KEY

Directions: Using the microprocessor trainer available to you, develop a program which will clear the accumulator, load the accumulator with the hexadecimal number 2E, add hexadecimal number 12 stored at memory location 0010, store the sum at memory location 0011, and clear the accumulator.

Step 1

Develop the flow chart or sequence structure

Sequence Structure

```
BEGIN
:     CLEAR ACC;
:     LOAD ACC WITH 2E IMMEDIATE;
:     ADD DIRECT 12;
:     STORE DIRECT AT 0011
:     CLEAR ACC;
END
```

Step 2

Write the program using the coding sheet for the microprocessor available to you. (MC6800 used only as example, actual code for your microprocessor may differ)

MC6800 code

```
CLRA            ;CLEAR ACCUMULATOR
LDAA      #2E   ;LOAD IMMEDIATE
ADDA      $10   ;ADD DIRECT
STAA      $11   ;STORE DIRECT
CLRA            ;CLEAR ACCUMULATOR
```

Machine code

addr	code
0000	4F
0001	86
0002	2E
0003	9B
0004	10
0005	97
0006	11
0007	4F
0008	3E

ACTIVITY SHEET

Directions: Using the microprocessor trainer and manual available to you, answer the following questions regarding the memory of the microprocessor.

1. When a program is developed and entered in the microprocessor, the program will be stored in memory called read/write, random access memory, or RAM. At what hexadecimal address does this memory begin?, end? Place your answer in the following blanks.

_____ starting address of RAM

_____ ending address of RAM

2. There is also a program which controls the operation of the microprocessor. This program is stored in an area of memory called read only memory, or ROM. Write the hexadecimal address of the beginning location of ROM

_____ beginning address of ROM.

Next, open up that address in ROM and examine its contents. Write the hexadecimal value of the first instruction in ROM.

_____ first instruction in ROM

Attempt to change the contents at this first address to FF hexadecimal. Were you able to change the contents of ROM? If no, explain.

_____

_____

_____

3. In your microprocessor manual there will be a graphic representation of the memory of the microprocessor called a memory map. According to the memory map the first address of user accessible RAM begins at

_____ (address user RAM begins).

Also, the memory map will list the ending address of user RAM. Write this address below

_____ (address user RAM ends).

Do these two addresses agree with your earlier findings? (yes or no, if no explain)

In similar fashion the memory map will list the beginning and ending addresses of ROM. Write the beginning and ending address below.

_____ beginning address of ROM

_____ ending address of ROM

Do these addresses agree with your previous addresses? (yes or no, if no explain)

There will be listed other areas available for additional memory. Write the addresses of those areas below.

The memory map provides the microprocessor user with a quick reference to those areas of memory already utilized, and other available areas for additional memory.

4. Two more types of memory often utilized with the microprocessor are PROM and EPROM. Using available resources define PROM and EPROM and explain how each might be used with your microprocessor trainer.

PROM --

EPROM --

How might each be used with your trainer?

ACTIVITY SHEET KEY

Directions: Using the microprocessor trainer and manual available to you, answer the following questions regarding the memory of the microprocessor.

1. When a program is developed and entered in the microprocessor, the program will be stored in memory called read/write, random access memory, or RAM. At what hexadecimal address does this memory begin?, end? Place your answer in the following blanks.

   0000 Hex starting address of RAM

   01FF Hex ending address of RAM

2. There is also a program which controls the operation of the microprocessor. This program is stored in an area of memory called read only memory, or ROM. Write the hexadecimal address of the beginning location of ROM

   FC00 Hex beginning address of ROM.

   Next, open up that address in ROM and examine its contents. Write the hexadecimal value of the first instruction in ROM.

   8E first instruction in ROM

   Attempt to change the contents at this first address to FF hexadecimal.
   Were you able to change the contents of ROM?, if no explain.

   The contents of ROM, while they can be examined, cannot be changed.

3. In your microprocessor manual there will be a graphic representation of the memory of the microprocessor called a memory map. According to the memory map the first address of user accessible RAM begins at

   0000 Hex (address user RAM begins).

   Also, the memory map will list the ending address of user RAM. Write this address below
   01FF Hex (address user RAM ends).

   Do these two addresses agree with your earlier findings? (yes or no, if no explain) YES.

In similar fashion the memory map will list the beginning and ending addresses of ROM. Write the beginning and ending address below.

FC00 Hex beginning address of ROM

FFFF Hex ending address of ROM

Do these addresses agree with your previous addresses? (yes or no, if no explain)

Yes

There will be listed other areas available for additional memory. Write the addresses of those areas below.

0200 RAM Hard Wired, C003-C006 Keyboard, C11F-C16F Display

The memory map provides the microprocessor user with a quick reference to those areas of memory already utilized, and other available areas for additional memory.

4. Two more types of memory often utilized with the microprocessor are PROM and EPROM. Using available resources define PROM and EPROM and explain how each might be used with your microprocessor trainer.

   PROM -- Programmable read only memory. A form of memory whose contents once programmed by the user are permanently fixed and cannot be altered.

   EPROM -- Erasable programmable read only memory. The contents of the ROM can be erased using a high-intensity ultraviolet light and the ROM reprogrammed.

   How might each be used with your trainer?

   PROMs or EPROMs can be used just like the ROM that is currently in your microprocessor trainer. These ROMs would provide you the opportunity to develop custom applications by programming your own operating system or other controlling sequence.

NOTE: this activity sheet was completed using the Heathkit ET 3400 microprocessor trainer. The answers you obtain will depend upon the microprocessor trainer you have available.

UNIT IV TEST

I. Directions: Match either or both the Harvard and von Neumann class architectures with their distinguishing characteristics. Place the correct answer in the blank space to the left of the characteristic.

_____	1. input medium	A.	Harvard class
_____	2. memory	B.	von Neumann class
_____	3. calculating section		
_____	4. decision capability		
_____	5. output medium		
_____	6. stored program		

II. Directions: In the following matching questions match the microprocessor unit with the correct description. Place the correct answer in the blank space immediately to the left of the number.

_____	1. Arithmetic/logic unit	A.	eight bit data highway on which data travels to and from memory
_____	2. Control logic unit	B.	contains the instruction which is being decoded and executed
_____	3. Instruction decoder	C.	performs arithmetical and logical operations on data received from memory
_____	4. Instruction register	D.	contains address in memory of instruction being processed
_____	5. Accumulator	E.	sixteen bit highway on which addresses of memory or I/O devices are opened or closed
_____	6. Memory data register	F.	controls the flow of data and instructions
_____	7. Memory data bus	G.	registers for temporary storage
_____	8. Memory address register	H.	examines the eight bit data word and decides which operation is being performed
_____	9. Memory address bus		

_____10. Program counter

_____11. Stack

_____12. Scratch pad memory

I. during arithmetic or logic operations it holds the result of the operation

J. array of registers which allows words or addresses to be accessed from the top in LIFO fashion

K. temporary storage location for data going to and from memory

L. temporary storage location holding the address of the memory location that is used in the operation being processed

III. Directions: Correctly label the block diagram of the hypothetical microprocessor. Place the correct answer in the blank space to the right of the number. The numbers below match numbers on the block diagram. The block diagram is attached to the end of this exam.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

11. _____

12. _____

13. _____

14. _____

IV. Directions: Develop a program w'ich will add three numbers together, increment the sum by 2, subtract 5 from the sum, and store the difference in memory location 0020. The numbers and their memory locations are as follows:

addr	value
0021	3E
0022	11
0023	02

V. Directions: Define the acronym and describe each type of memory listed below.

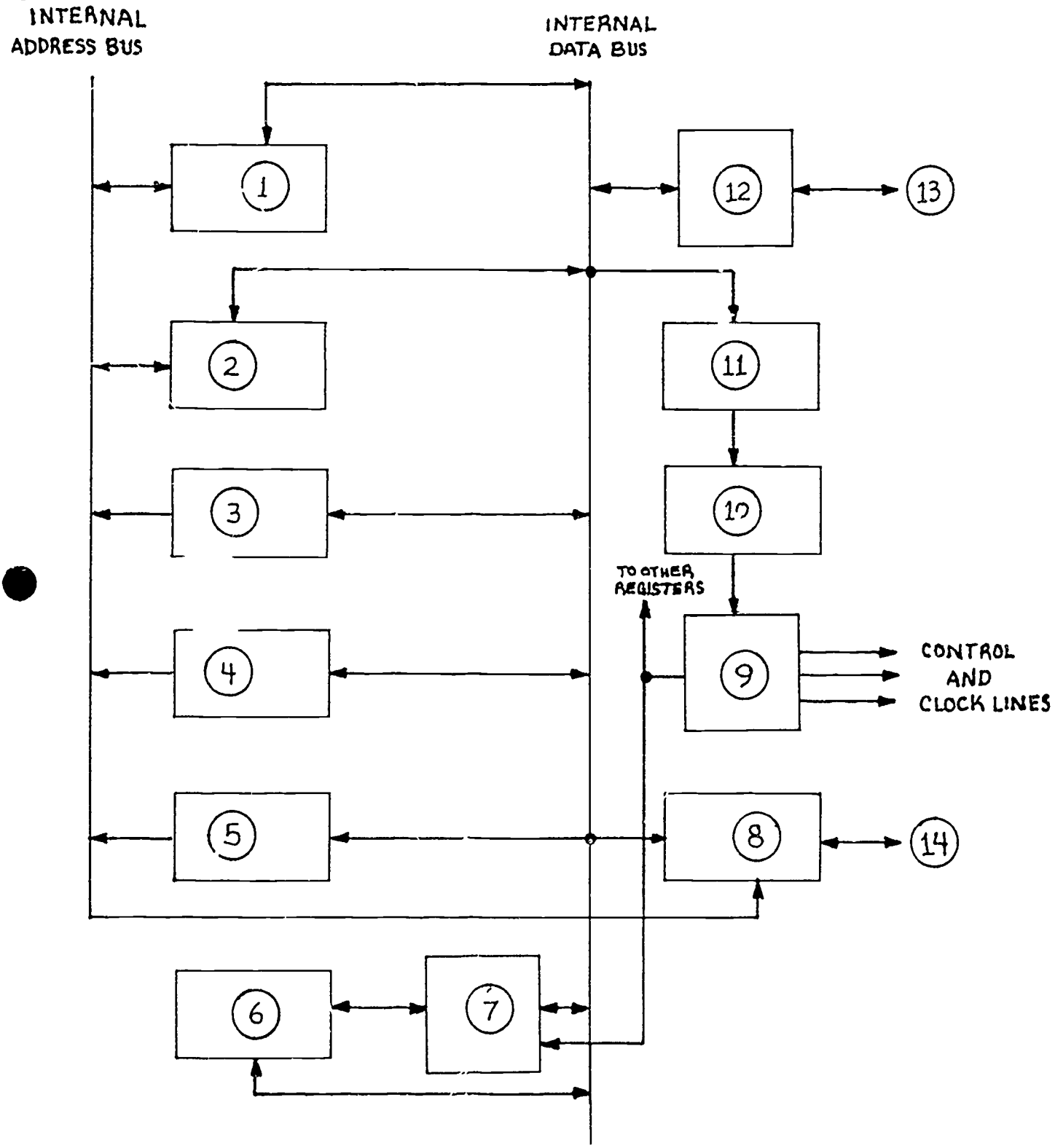
A. RAM --

B. ROM --

C. PROM --

D. EPROM --

HYPOTHETICAL MICROPROCESSOR ARCHITECTURE



UNIT IV TEST KEY

I. 1) AB; 2) AB; 3) AB; 4) AB; 5) AB; 6) B

II. 1) C; 2) F; 3) H; 4) B; 5) I; 6) K; 7) A; 8) L; 9) E; 10) D; 11) J; 12) G

III. 1) Index Register; 2) Stack; 3) Program Counter; 4) Accumulator; 5) Scratch Pad Memory; 6) Status Register; 7) Arithmetic/Logic unit; 8) Memory Address Register; 9) Control Logic Unit; 10) Instruction Decoder; 11) Instruction Register; 12) Memory Data Register; 13) Memory Data Bus; 14) Memory Address Bus

IV. sequence structure

```
BEGIN
:    LOAD ACC DIRECT WITH 3E
:    ADD DIRECT 11
:    ADD DIRECT 02
:    INCREMENT ACC
:    INCREMENT ACC
:    SUBTRACT IMMEDIATE 5
:    STORE DIRECT AT 0020
END
```

MC6800 code

```
0001          LDAA    $21   ;load accumulator direct
0002          ADDA    $22   ;add to accumulator direct
0003          ADDA    $23   ;add to accumulator direct
0004          INCA          ;increment accumulator by 1
0005          INCA          ;increment accumulator by 1
0006          SUBA    #05    ;subtract  from accumulator
                            immediate
0007          STAA    $20   ;store accumulator direct
0008          WAI
```

Machine code

```
0000    96
0001    21
0002    9B
0003    22
0004    9B
0005    23
0006    4C
0007    4C
0008    80
0009    05
000A    97
000B    20
000C    3E
```

V. RAM -- Read/write random access memory. RAM is used to store data which changes during the operation of the system. RAM can be read from or written into.

ROM -- Read only memory. ROM is used to store constant program steps and data values. ROMs can be read by the user but not written into.

PROM -- Programmable read only memory. A form of memory whose contents once programmed by the user are permanently fixed and cannot be altered.

EPROM -- Erasable programmable read only memory. The contents of the ROM can be erased using a high-intensity ultraviolet light and the ROM reprogrammed.

EVALUATION AND TESTING

Students will be evaluated by the following guidelines:

1. Complete unit test with at least 70 percent accuracy.
2. Complete research assignments with acceptable minimum performance as determined by the instructor.
3. Demonstrate the ability to read and comprehend.
4. Demonstrate ability to identify meaning of unknown words or common terms.
5. Demonstrate resourcefulness in locating information.
6. Demonstrate ability to record outline notes that provide accurate and complete information needed for future use.
7. Actively participating in class discussions.

EQUIPMENT AND SUPPLIES

Microprocessor trainer1
Overhead projector
Transparency materials

NOTES

1 Manufacturers of microprocessor trainers include Heath Company, Lab Volt, E and L Instruments, Hickock, Digiac, and Intel. This list in no way represents all manufacturers. Whichever microprocessor trainer is chosen should have the following capabilities: display for examining contents of memory locations, single step program execution, keypad for control of and entry into the microprocessor, breadboarding capabilities for the possibility of interfacing experiments, user accessible memory for the storage of programs, and the ability to examine key microprocessor registers such as the accumulator(s), status registers, index register, program counter, and available register pairs (if applicable).

BULLETIN BOARD IDEAS

The functional components of the microprocessor architecture can be constructed from colored construction paper and then arranged on the bulletin board. Students should scan newspapers and periodicals for noteworthy topics relating to microprocessors and society. These articles should then be placed on the bulletin board as a reminder to the students of the significant role microprocessors have in our society. If old computer boards are available, attach these to the bulletin board or place in a visible location to illustrate the rapid advancement of technology.

SUPPLEMENTARY MATERIALS

SELECTED BIBLIOGRAPHY

Gilmore, Charles M. Introduction to Microprocessors. New York: McGraw-Hill Book Company, 1981.

Gilmore, Charles M. Activities Manual for Introduction to Microprocessors. New York: McGraw-Hill Book Company, 1981.

Hall, Douglas V. Microprocessors and Digital Systems. New York: McGraw-Hill Book Company, 1983.

Hall, Douglas V., and Hall, Marybelle B. Experiments in Microprocessors and Digital Systems. New York: McGraw-Hill Book Company, 1981.

Hilburn, John L., and Julich, Paul M. Microcomputers/ Microprocessors: Hardware, Software, and Applications. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1976.

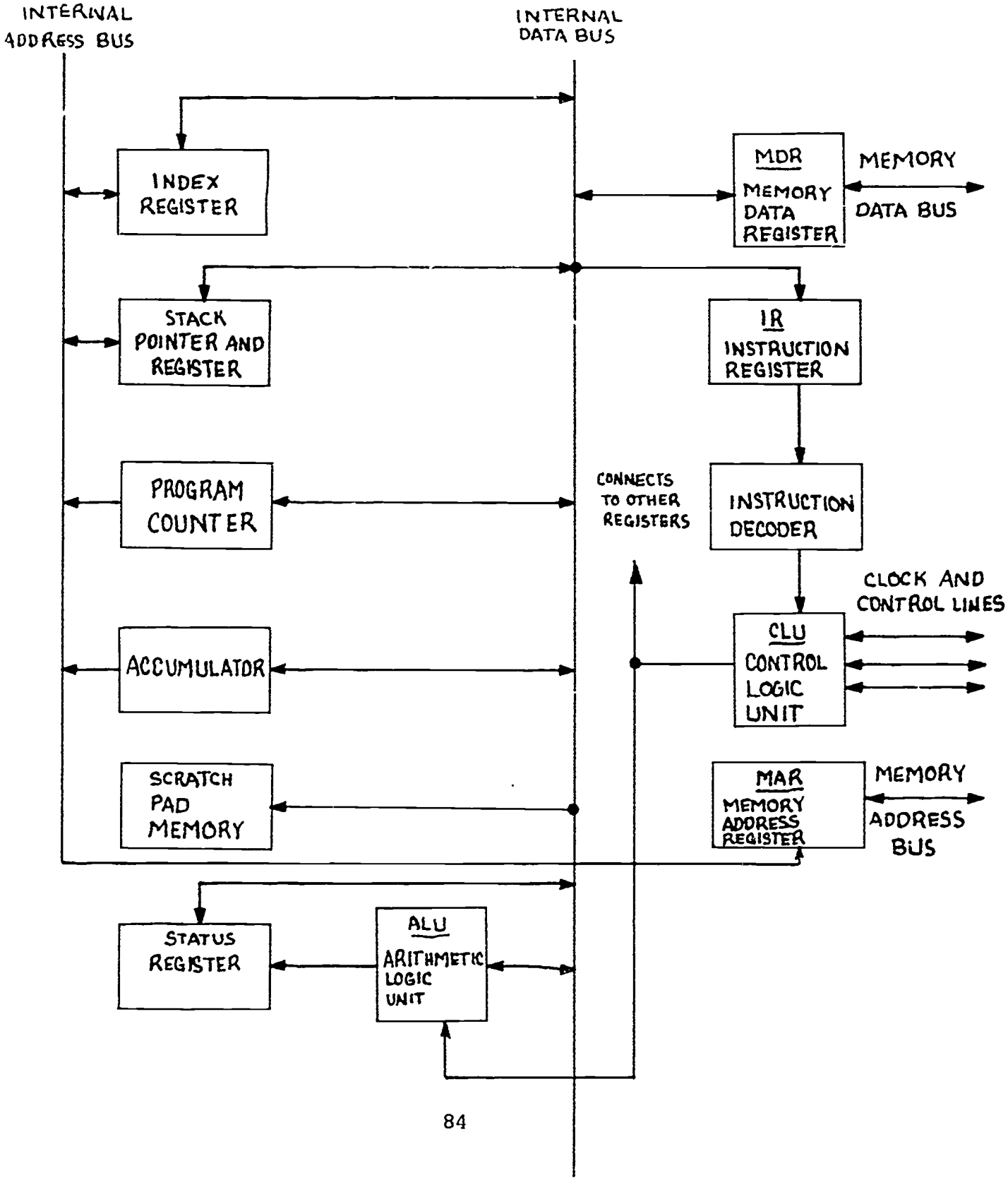
McKay, Charles W. Introduction to Microprocessors and Microcomputer Systems. Hickock Teaching Systems, 1978.

Microprocessors, Heathkit Continuing Education Series. Benton Harbor, Michigan: Heath Company, 1977.

Zaks, Rodnay. Programming the Z80. SYBEX Inc., 1982.

OVERHEAD TRANSPARENCIES

HYPOTHETICAL MICROPROCESSOR ARCHITECTURE



UNIT V

INTRODUCTION TO COMPUTER HARDWARE

INTRODUCTION

Reviewing our past lessons brings into focus three main precepts: the history of computing is today; without digital electronics we would have never progressed this far; and the advent of the microprocessor has provided Americana the opportunity to participate in the computer revolution. We are in the midst of a revolution the likes of which have never before been experienced. Not even the industrial revolution could import upon society the exponential proportions of growth we have experienced in the last fifteen years, or will experience in the next fifteen years. The mandate is upon us, link-up or be consumed as a second in the passing of time.

In this lesson we will establish a solid base for understanding the protagonist of the revolution--computer hardware. The laws of economy of scale have reduced the cost of computer hardware to a point where, realistically, every American will have contact with our revolutionary champion. It is therefore our responsibility to establish the foundation upon which we can build our new society.

COMPETENCIES

1. Organize the components of a computer system as classified by size.
2. Structure the input/output devices of a computing system.
3. Relate the components of a computing system to the real world.
4. Establish system configuration parameters for typical applications.

GENERAL PERFORMANCE OBJECTIVES/GOALS

1. Identify the computer system as either microcomputer, minicomputer, large computer, or super computer.
2. Understand the operation and interfacing of input/output devices.
3. Recognize operating and interfacing principles of peripheral environments.
4. Assign slots and/or ports for a typical microcomputer application.

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4. Assign slots and/or ports for a typical microcomputer application.

UNIT V OUTLINE

INTRODUCTION TO COMPUTER HARDWARE

I. Components of a computer system
   - A. Classification by size
     1. Microcomputer
     2. Minicomputer
     3. Mainframe
   - B. Input/output devices
     1. Monitor/keyboard
     2. Cassette/disk
     3. Printers
   - C. Communications devices
     1. Serial/parallel
     2. Modem
   - D. Transducers
     1. Pressure
     2. Temperature
     3. Proximity
     4. Light

II. Microcomputer system configuration
   - A. Hardware
     1. Monitor/keyboard
     2. Disk/cassette
     3. Printer
     4. Mouse, joysticks, game paddles
   - B. Slots and Card Assignments
     1. Apple
     2. IBM
     3. Student's home computers

SPECIFIC PERFORMANCE OBJECTIVES

1.1 On a written examination, students will demonstrate their knowledge of computer systems by distinguishing between computing systems according to size.

Subject Matter Content	Learning Activities
Classification of computer systems according to size	1. Plan a lecture, using the personal computer as a demonstration model, covering the classifications of computers according to size.

2. Coordinate a field trip to a local company utilizing as many different sizes of computing system available.
3. Students should complete a checklist noting the different sizes of equipment available.

2.1 On a written examination, students will demonstrate their knowledge of input/output devices by describing peripheral equipment as either input or output.

Subject Matter Content	Learning Activities
Identification of input/output devices	1. Using the available microcomputer as a working model demonstrate and identify the various input/output devices connected to the computing system. 2. Plan a trip to other departments utilizing computer equipment. 3. Students should complete a checklist describing input/output devices utilized by each department.

3.1 On a written examination, students will demonstrate their knowledge of interfacing by distinguishing between communications equipment and transducing equipment.

Subject Matter Content	Learning Activities
Interfacing of communications and transducing equipment	1. Using the available microcomputer as a working model, distinguish the interfacing techniques

	involved in connecting communications and transducing equipment to the microcomputer. 2. Describe the differences between serial and parallel printer interfaces. 3. If a modem is available, demonstrate using the telephone line as a communications link with other computer systems.

4.1 On a written examination, students will demonstrate their knowledge of a personal computer system configuration by identifying the common components and slot/port assignments.

Subject Matter Content	Learning Activities
Identification of personal computer slot/port assignments	1. Using the available personal computer as a demonstration model, identify the slot/port assignments used by the personal computer in interfacing to peripheral equipment 2. If other personal computer systems are available, have the students complete a configuration chart for each computer.

ACTIVITY SHEET

Directions: Describe the following classes of computer systems according to size and speed.

A. Super computers--

B. Large computers--

C. Minicomputers--

D. Microcomputers--

ACTIVITY SHEET KEY

Directions: Describe the following classes of computer systems according to size and speed.

A. Super computers--are the biggest and fastest machines today, usually special purpose, single application machines, equal in size to several large mainframe computers. These machines can do hundreds of millions of calculations per second. An example of a super computer is CRAY-1, designed by Seymour Cray, and used by Los Alamos Scientific Laboratory for nuclear weapon design.

B. Large computers--called mainframe computers and are one step down in size from the super computers, however, they are much more flexible and cost effective. These machines can process approximately 15 million instructions per second (MIPS), have memory sizes of up to 96 million bytes, and cost anywhere from 3 million to 5 million dollars.

C. Minicomputers--typical minicomputer has a 16 to 32 bit word length, weigh approximately 50 pounds, require no special cooling system(s), can process in the range of 1 to 5 MIPS, and cost less than $100,000. These machines are extremely flexible but cannot support the number of users and memory of the two larger systems.

D. Microcomputers--normally thought of as the personal computer (PC), these machines have grown so in popularity due to low cost and increased computing power they are now competing with many of the minicomputers for their market share. A microcomputer will usually have a single microprocessor, or single board computer having multiple microprocessors, cost less than $20,000, can work as fast as 1 MIPS, memory size up to 16 megabytes, and a wide variety of peripheral devices available from computer aided design (CAD) and robotics to video and graphics equipment.

ACTIVITY SHEET

Directions: Using the available microcomputer and the manual, list below the peripheral equipment interfaced with the computer system.

1. What type of microcomputer do you have?

2. Is there a monitor/keyboard attached? If so, what type of video signal is used?

3. If no monitor is attached, what type of video output device(s) are attached to your computer?

4. Is the keyboard part of the monitor or attached separately? If attached separately, what type of connector is used to attach the keyboard?

5. Most computer systems have a device for the storage of information external to the machine. Does your computer have such a device, and is it a cassette, floppy disk drive (include size), or hard disk drive?

6. When a hard copy (printed copy) of information is needed most computer systems use a printer. Does your computer system have a printer attached? If so, what type of printer is it, dot matrix or letter quality? Also, indicate the brand name of the printer.

7. Using the manual that comes with your computer, list other peripheral devices which may be connected to your computer system. Also indicate which of these devices are currently connected.

8. Now, construct a chart of your computer system indicating which items above you currently have connected to your system. Also indicate whether each device is input or output.

ACTIVITY SHEET KEY

NOTE: Answers to the following questions will depend upon the type of computer system you have access to. The following answers are for an Apple IIe, 640K memory, profile 5MB hard disk, two 5 1/4 inch floppy drives, and Imagewriter printer.

Directions: Using the available microcomputer and the manual, list below the peripheral equipment interfaced with the computer system.

1. What type of microcomputer do you have?
   Apple IIe
2. Is there a monitor/keyboard attached? If so, what type of video signal is used? Yes there is a monochrome monitor attached. It uses a composite video signal supplied by the computer.
3. If no monitor is attached, what type of video output device(s) are attached to your computer? Not applicable
4. Is the keyboard part of the monitor or attached separately? If attached separately, what type of connector is used to attach the keyboard?
   The keyboard is part of the computer case and is attached by connectors attached to the end of ribbon cable to the computer's mother board.
5. Most computer systems have a device for the storage of information external to the machine. Does your computer have such a device, and is it a cassette, floppy disk drive (include size), or hard disk drive?
   We have two of the above. Two 51/4 floppy drives are attached to a disk drive controller on the computer mother board. There is also a 5 megabyte profile hard disk attached to its controller on the mother board.
6. When a hard copy (printed copy) of information is needed most computer systems use a printer. Does your computer system have a printer attached? If so, what type of printer is it, dot matrix or letter quality? Also, indicate the brand name of the printer.
   The printer currently attached to the Apple IIe is the Apple Imagewriter II printer. This is a dot matrix printer with near letter quality (NLQ) and graphics capabilities.
7. Using the manual that comes with your computer, list other peripheral devices which may be connected to your computer system. Also indicate which of these devices are currently connected.
   An Apple Mouse may also be connected as well as joy sticks for playing games. Neither of the above two are currently connected.

8. Now, construct a chart of your computer system indicating which items above you currently have connected to your system. Also indicate whether each device is input or output.

Monitor -- Apple monochrome, output
Floppy disk -- Two Apple 51/4, input/output
Hard disk -- Apple Profile 5 megabyte hard disk, input/output
Printer -- Apple Imagewriter II, output
Memory -- Applied Engineering 512KB add-on, input/output
Keyboard -- Apple keyboard which is part of the main housing, input

ACTIVITY SHEET

STUDENT FIELD TRIP

Directions: Complete the following checklist regarding the computer installation(s) you visit.

1. Company

   name _____

   address _____

   city, state zip _____

2. Contact person

   name _____

   position _____

3. Date of visit

   month _____ day _____ year _____

4. Departments visited (list in order visited)

5. Computer systems and number of each

   Mainframe _____

   Minicomputer _____

   Microcomputer _____

6. Nature of business

7. Application for computer system

   Mainframe _____

   Minicomputer _____

   Microcomputer _____

8. Result of visit

ACTIVITY SHEET KEY

NOTE: The answers for this activity sheet will depend upon the business visited. These sheets should stimulate the students to ask questions and maintain concentration throughout the visit. The following was completed following a visit to Blue Cross of Louisiana.

1. Company

   name Blue Cross of Louisiana
   address Blue Cross Parkway
   city, state zip Baton Rouge, LA 70809

2. Contact person
   name John Fallon
   position Vice President, Data Processing

3. Date of visit
   month June day 15 year 1985

4. Departments visited (list in order visited)
   a. Data processing
   b. Claims
   c. Customer service
   d. Business systems

5. Computer systems and number of each
   Mainframe IBM 3033
   Minicomputer DEC PDP-11/70
   Microcomputer IBM PC's

6. Nature of business
   Health insurance

7. Application for computer system

   Mainframe All hospital claims enter here

   Minicomputer Front end processor to control communication

   Microcomputer Personal productivity and business systems

8. Result of visit
   All facets of data processing were evident here. This is one of the largest computer installations in the state. Without the computer, processing of claims from all over the state would come to a standstill. The computer is indispensable.

ACTIVITY SHEET

SCHOOL DEPARTMENTAL FIELD TRIP

Directions: In coordination with various school departments, plan a field trip to view computer hardware availability in each department. In conjunction with the field trip you are to complete the following computer hardware availability schedule for each department visited and computer system evaluated.

1. Department _____

2. Contact person _____

3. Date of visit _____

4. Computer hardware availability

   a. Computer name _____

   b. Options

      1) Memory _____
      2) Disk drive(s) _____
      3) Hard disk _____
      4) Graphics _____
      5) Color/monochrome _____
      6) Mouse _____
      7) Other special features _____
      _____
      _____

   c. Printer name _____

   d. Printer options _____

5. List software packages available to run on the above computer

   _____

   _____

6. Is there a modem available, and if so what type

   _____

   _____

Evaluator _____

ACTIVITY SHEET KEY

SCHOOL DEPARTMENTAL FIELD TRIP

Directions: In coordination with various school departments, plan a field trip to view computer hardware availability in each department. In conjunction with the field trip you are to complete the following computer hardware availability schedule for each department visited and computer system evaluated.

1. Department Office Occupations

2. Contact person Mr. Bourgeois

3. Date of visit April 12, 1985

4. Computer hardware availability

   a. Computer name IBM Personal Computer

   b. Options

      1) Memory 256K

      2) Disk drive(s) 2 5¼ 360K

      3) Hard disk No

      4) Graphics No

      5) Color/monochrome monochrome

      6) Mouse No

      7) Other special features None

   c. Printer name IBM Proprinter

   d. Printer options Dot matrix, 5K buffer, graphics capability

5. List software packages available to run on the above computer
   Displaywrite 3, Lotus 123, dBase III

6. Is there a modem available, and if so what type
   No

EVALUATOR Howard Williams

ACTIVITY SHEET

Directions: Using the available resource materials, describe the following terms as they relate to computer interfacing.

I. Communication devices

A. Serial communications

B. Parallel communications

C. Modem

II. Transducer devices

A. Pressure

B. Temperature

C. Proximity

D. Light

ACTIVITY SHEET KEY

Directions: Using the available resource materials, describe the following terms as they relate to computer interfacing.

I. Communication devices

A. Serial communications--sends information one bit at a time. This method of data transmission usually uses a standardization called RS-232C. Bits are transmitted in tandem, one behind the other, or serial. Information which travels over the telephone line is transmitted via serial communications ports.

B. Parallel communications--the computer sends eight bits or one full character at a time. This requires eight wires running in parallel from the device to the computer, one line for each bit. Many printers use parallel communications ports, called centronics parallel.

C. Modem--a special device which sends computer signals over the phone lines. It will allow one computer to send information to another computer regardless of the types of computers communicating. Namely, computers that are incompatible any other way can communicate using a modem.

II. Transducer devices

A. Pressure--used to sense pressure in both hydraulic and pneumatic systems. Converts pressure into either voltage or current. This voltage or current must then be converted into a digital signal (analog to digital conversion) for use by the computer.

B. Temperature--the thermocouple is used for measuring temperature. A junction between any two dissimilar metals will output a voltage, the magnitude of which is relative to the temperature of the junction. This is the principle upon which the thermocouple works. This output voltage is then converted into a digital signal for use by the computer.

C. Proximity--detects the presence of an object when the object is within a specified range of the detector. Again, the output of the proximity indicator must be digitized for use by the computer.

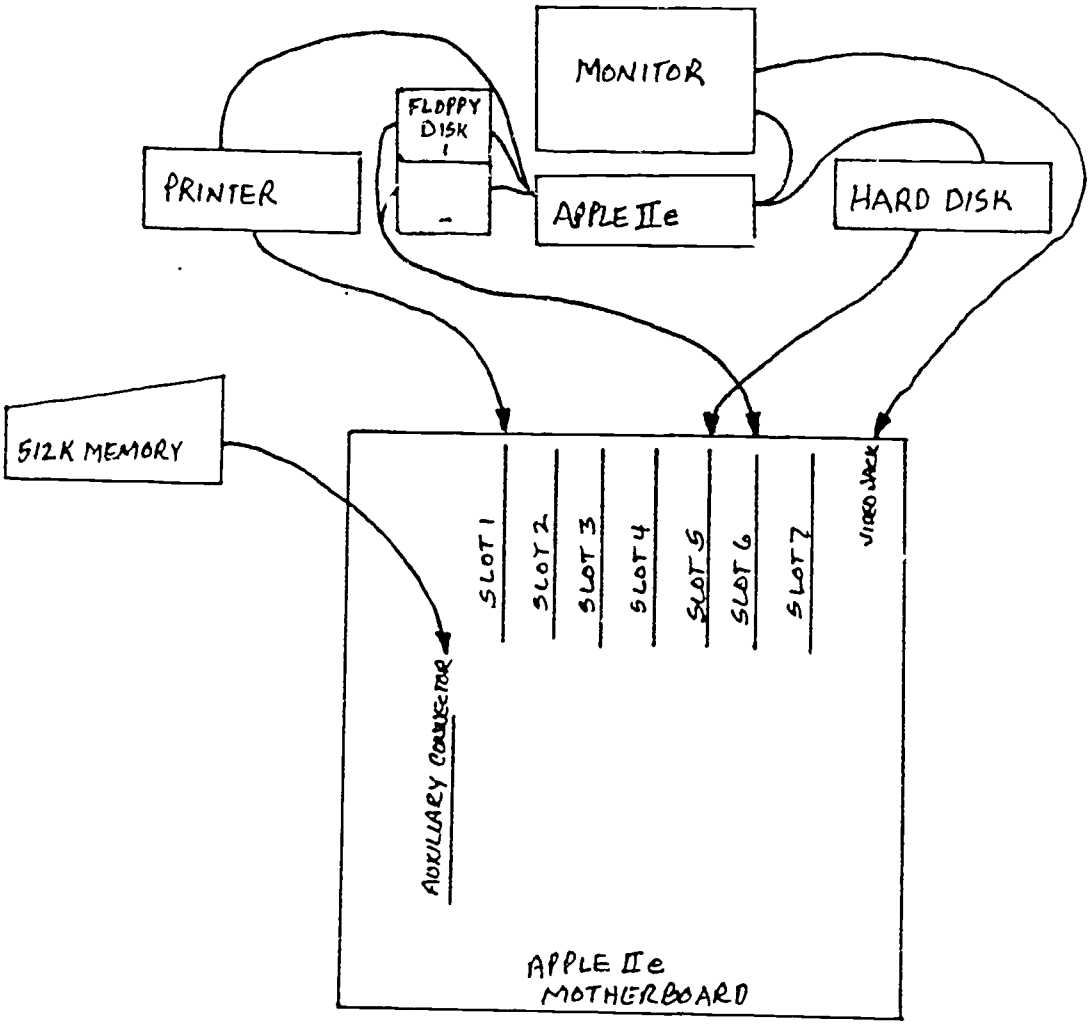
A. Light--will detect the presence of an object when the object breaks a light beam or reflects a light beam to a receiver. Photoconductive and photovoltaic devices are two types of light transducers. Again the output voltage must be digitized to be useful to the computer.

ACTIVITY SHEET

Directions: Using the available microcomputer as a working model, draw the system configuration chart for your computer. Use the computer manuals and the actual computer to determine system configuration.

ACTIVITY SHEET KEY

NOTE: The following configuration chart is developed using an Apple IIe with 512K of memory, Profile 5MB hard disk, 2 5¼ floppy disk, Imagewriter printer, and an Apple monochrome monitor. Your configuration will depend upon the computer system you have available.



AUXILLARY CONNECTOR - 512K MEMORY

SLOT 1 - PRINTER

SLOTS 2-4 - OPEN

SLOT 5 - HARD DISK

SLOT 6 - FLOPPY DISK

SLOT 7- OPEN

VIDEO JACK- MONITOR

UNIT V TEST

I. Directions: Describe the following classes of computer according to size and speed.

A. Super computers

B. Large computers

C. Minicomputers

D. Microcomputers

II. Directions: Identify the following as either INPUT, OUTPUT, or INPUT/OUTPUT. Place the correct answer in the blank to the left of the numbered item.

_____ 1. Monitor

_____ 2. Keyboard

_____ 3. Cassette

_____ 4 Floppy disk

_____ 5. Printer

_____ 6. Hard disk

_____ 7. Memory

_____ 8. Game paddle

_____ 9. Mouse

III. Directions: Match the word on the left to the word(s) on the right. Place the correct letter in the blank to the left of the numbered item.

_____	1.	Serial	A. Presence
_____	2.	Parallel	B. Centronics
_____	3.	Modem	C. Pneumatic
_____	4.	Pressure	D. Reflection to receiver
_____	5.	Temperature	E. RS-232C
_____	6.	Proximity	F. Telephone line
_____	7.	Light	G. Thermocouple

IV. Directions: Complete a configuration chart for the following computer: Apple IIe, printer, hard disk, one floppy disk, mouse, and monitor.

UNIT V TEST KEY

I. Directions: Describe the following classes of computer according to size and speed.

A. Super computers--are the biggest and fastest machines today, usually special purpose, single application machines, equal in size to several large mainframe computers. These machines can do hundreds of millions of calculations per second. An example of a super computer is CRAY-1, designed by Seymour Cray, and used by Los Alamos Scientific Laboratory for nuclear weapon design.

B. Large computers--called mainframe computers and are one step down in size from the super computers, however, they are much more flexible and cost effective. These machines can process approximately 15 million instructions per second (MIPS), have memory sizes of up to 96 million bytes, and cost anywhere from 3 million to 5 million dollars.

C. Minicomputers--typical minicomputer has a 16 to 32 bit word length, weigh approximately 50 pounds, require no special cooling system(s), can process in the range of 1 to 5 MIPS, and cost less than $100,000. These machines are extremely flexible but cannot support the number of users and memory of the two larger systems.

D. Microcomputers--normally thought of as the personal computer (PC), these machines have grown so in popularity due to low cost and increased computing power they are now competing with many of the minicomputers for their market share. A microcomputer will usually have a single microprocessor, or single board computer having multiple microprocessors, cost less than $20,000, can work as fast as 1 MIPS, memory size up to 16 megabytes, and a wide variety of peripheral devices available from computer aided design (CAD) and robotics to video and graphics equipment.

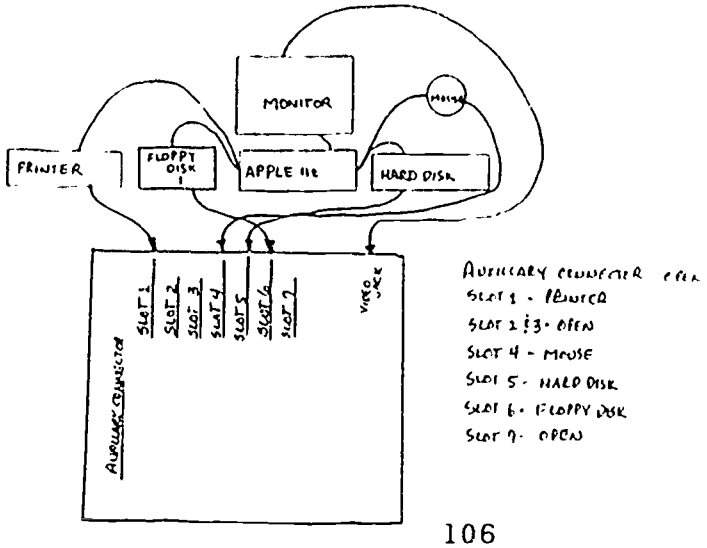
II. Directions: Identify the following as either INPUT, OUTPUT, or INPUT/OUTPUT. Place the correct answer in the blank to the left of the numbered item.

OUTPUT	1.	Monitor	INPUT/OUTPUT	7.	Memory
INPUT	2.	Keyboard	INPUT	8.	Game paddle
INPUT/OUTPUT	3.	Cassette	INPUT	9.	Mouse
INPUT/OUTPUT	4.	Floppy disk			
OUTPUT	5.	Printer			
INPUT/OUTPUT	6.	Hard disk			

III. Directions: Match the word on the left to the word(s) on the right. Place the correct letter in the blank to the left of the numbered item.

E	1.	Serial	A.	Presence
B	2.	Parallel	B.	Centronics
F	3.	Modem	C.	Pneumatic
C	4.	Pressure	D.	Reflection to receiver
G	5.	Temperature	E.	RS-232C
A	6.	Proximity	F.	Telephone line
D	7.	Light	G.	Thermocouple

IV. Directions: Complete a configuration chart for the following computer: Apple IIe, printer, hard disk, one floppy disk, mouse, and monitor.



EVALUATION AND TESTING

Students will be evaluated by the following guidelines:

1. Completing unit test with at least 70 percent accuracy.
2. Complete research assignments with acceptable minimum performance as determined by the instructor.
3. Demonstrate the ability to read and comprehend.
4. Demonstrate the ability to identify meaning of unknown words or common terms.
5. Demonstrate resourcefulness in locating information.
6. Demonstrate the ability to record outline notes that provide accurate and complete information needed for future use.
7. Demonstrate the ability to complete projects in a timely manner.
8. Actively participate in class discussions.

EQUIPMENT AND SUPPLIES

Teachers:

Microcomputer[1]
Overhead projector
Transparency materials

NOTES

[1] Each school will have a different variety of microcomputers and personal computers available. This is not to imply that Apple is the only system which can be utilized to accomplish the preceding checklists and activity sheets. Any small computer will work.

BULLETIN BOARD IDEAS

Once a particular industry has been decided for the field trip, students should then be assigned the task of researching the industry for information regarding its size, organizational structure, location of home office, and impact on the local economy. Newsworthy articles should be attached on the bulletin board. Periodicals should be scanned for information concerning that particular industry. One student should be assigned the responsibility of contacting the organization for pictures which could be attached to the bulletin board.

SUPPLEMENTARY MATERIALS

SELECTED BIBLIOGRAPHY

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Coburn, Edward J. Learning About Microcomputers, Hardware and Applications Software. New York: Delmar Publishers Inc., 1986.

Critchlow, Arthur J. Introduction to Robotics. New York: Macmillan Publishing Company, 1985.

Flores, Ivan. The Professional Microcomputer Handbook. New York: Van Nostrand Reinhold Company, 1986.

Gibson, Harry L., and Rademacher, Robert A. An Introduction to Computers and Information Systems. Cincinnati: South-Western Publishing Co., 1983.

Hall, Alix-Marie, Muscat, Eugene, and Robichaud, Beryl. Introduction to Data Processing. New York: McGraw-Hill Book Company, 1983.

Hoekstra, Robert L. Robotics and Automated Systems. Cincinnati: South-Western Publishing Co., 1986.

Lambrecht, Judith J., Wagner, Gerald E., and Wanous, S. J. Fundamentals of Data Processing. Cincinnati: South-Western Publishers Inc., 1981.

Long, Larry. Introduction to Computers and Information Processing. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1984.

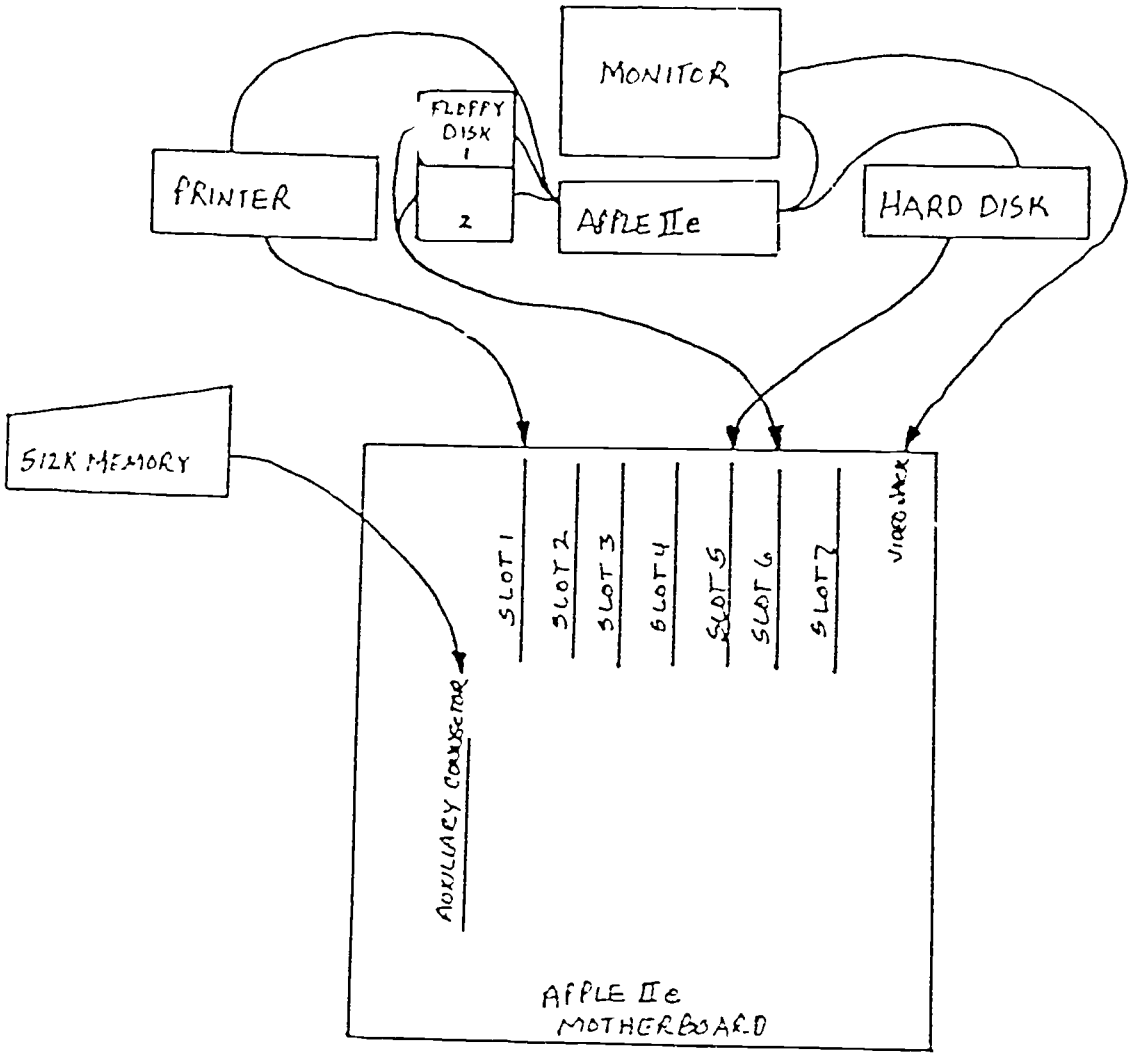
Sardinas, Joseph L., Jr. Computing Today, An Introduction to Business Data Processing. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1981.

OVERHEAD TRANSPARENCIES

Configuration Charts

CONFIGURATION CHART

APPLE IIe



AUXILLARY CONNECTOR - 512K MEMORY

SLOT 1 - PRINTER

SLOTS 2-4 - OPEN

SLOT 5 - HARD DISK

SLOT 6 - FLOPPY DISK

SLOT 7- OPEN

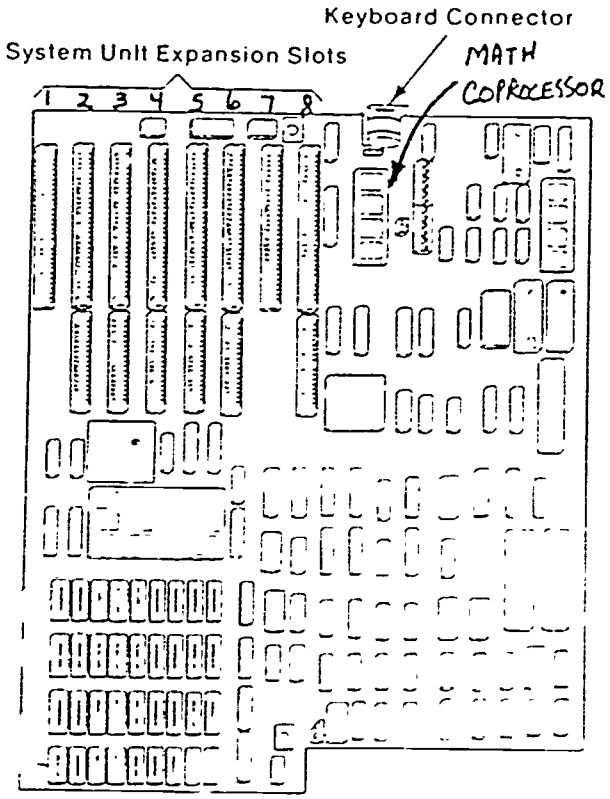
VIDEO JACK- MONITOR

CONFIGURATION CHART

IBM PC AT

Top View of System Board

IBM PC AT



SLOT 1 - GRAPHICS CARD

SLOT 2 - OPEN

SLOT 3 - 512K MEMORY ADDON

SLOTS 4-7 - OPEN

SLOT 8 - DISK DRIVE CONTROLLER

UNIT VI

INTRODUCTION TO SOFTWARE

INTRODUCTION

All of the hardware studied thus far would be no more than fancy electrical circuits, if it were not for software. Software contains the plan and the sequence, accepts the inputs, determines the solutions, and provides the output to execute the will of the users of computer technology.

In this unit we will begin with the characteristics of disk operating systems (DOS). Next, we will examine the kinds of programming languages available to those interested in microcomputers and robotics. Finally, we will learn how to program in Basic, as it is the most commonly used microcomputer programming language.

COMPETENCIES

1. Distinguish accurately among programming languages.
2. List features common to disk operating systems (DOS) of your microcomputers.
3. Differentiate between operating and application languages.
4. Determine correctly the output of sample Basic programs.
5. Discuss robotic languages developed by various manufacturers.
6. Program a Microbot robot using Armbasic, or a Rhino XR3 using Robotalk (if available).

GENERAL PERFORMANCE OBJECTIVES AND GOALS

1. Recognize differences among programming languages.
2. Learn disk operating system (DOS) features of your microcomputers.
3. Demonstrate knowledge of the proper handling and storing of diskettes.
4. Recognize differences between operating and application languages.
5. Interpret BASIC coding and determine the purpose of a program by analyzing the instructions.
6. Recognize industrial robot manufacturers by their robotic language.
7. Learn how to enter data into a computer, modify the data, and produce a useful output.
8. Program a Microbot robot using Armbasic or a Rhino XR3 using Robotalk.

SPECIFIC PERFORMANCE OBJECTIVES AND MASTERY CRITERIA

1.1 On a written test, students will demonstrate their knowledge of programming languages by explaining the trade-off between coding time and complexity of task among machine languages, assembly languages, and high level languages.

2.1 On a written test, students will demonstrate their knowledge of disk operating systems (DOS) by describing their general characteristics and listing specific DOS versions and their associated microcomputer manufacturers.

2.2 On a written test, students will demonstrate their knowledge of the handling of diskettes and other magnetic storage devices by listing the necessary safety precautions.

2.3 In an exercise to create a copy of a master diskette, students will use the backup utility program and be able to distinguish utility programs from DOS programs.

3.1 On a written test, students will demonstrate their knowledge of application software by distinguishing it from system software.

4.1 On a written test, students will demonstrate their knowledge of BASIC by correctly assigning values to variables using LET, INPUT, and READ statements.

4.2 On a written test, students will demonstrate their knowledge of instructions in BASIC that manipulate data by correctly anticipating the solution to mathematical statements.

4.3 On a written test, students will demonstrate their knowledge of unconditional and conditional instructions by correctly listing the sequence of statement execution in a BASIC program containing many branching opportunities.

4.4 On a written test, students will demonstrate their knowledge of output commands by correctly using PRINT, PRINT comma, PRINT semi-colon, PRINT TAB, and other graphics features special to the microcomputer they have available to them.

5.1 On a written test, students will demonstrate their knowledge of robotic languages by correctly associating the names of industrial robot manufacturers with their robotic language.

5.2 Should the equipment be available, students will demonstrate their knowledge of a robot control language by writing a program under the direction of the instructor.

METHODOLOGY

At the heart of Industrial Arts/Technology Education is the belief that students learn faster and retain longer when hands-on activities are generously included within instructional time. Hence, it is recommended that students learn about the features available in most system and application software by using those features. Teachers who incorporate time-on tasks into the daily curriculum are providing their students with the most effective instruction.

As equipment and time permit, students should become familiar with hardware and software from more than one manufacturing company. If possible, instructions on how to program a robot using a user-friendly application program should also be given.

SUGGESTED INTEREST APPROACHES

1. Require students to use a notebook divided into sections to include: (1) class notes; (2) safety notes; (3) old tests and quizzes; (4) diskette handling information; and (5) individual sections devoted to each microcomputer and disk operation unique to a manufacturer.
2. Encourage students to write computer assisted instruction programs on the four resistance formulas, resistor color codes, or scientific notation. Such assignment guarantees that students actually know the material and are accurately able to anticipate possible responses to their program.
3. Provide a robot for class study. Armatron by Radio Shack can provide insight into the nature of robotics at a reasonable cost.
4. Encourage students to learn to use a word processor, a computer aided drafting (CAD) package and a spreadsheet program. The use of such software is increasing throughout the industrial and academic worlds.

UNIT VI OUTLINE

INTRODUCTION TO SOFTWARE

I. Programming languages
   - A. Machine
   - B. Assembly
   - C. High Level

II. Disk operating systems (DOS)
   - A. Characteristics
   - B. Examples

C. Care
D. Utilities

III. Application Software
A. Definition
B. Examples

IV. BASIC
A. Values and variables
B. Computations
C. Decisions
D. Sample programs

V. Robotic languages
A. Kinds
B. Programming in Armbasic/Robotalk

SPECIFIC PERFORMANCE OBJECTIVES

1.1 On a written test, students will demonstrate their knowledge of programming languages by explaining the trade-off between coding time and complexity of task among machine languages, assembly languages, and high level languages.

Subject Matter Content	Learning Activity
Programming Languages	Reviewing examples of machine language program, an assembly language program, and an interpreter program with similar or identical objectives and discussing the amount of training a programmer must have to write in each language in preparation for a unit test.

1.2 On a written test, students will demonstrate their knowledge of disk operating systems (DOS) by describing their general characteristics and listing specific DOS versions and associated microcomputer manufacturers.

Subject Matter Content	Learning Activities
Disk Operating System (DOS) Versions and Characteristics	1. Noting that manufacturers sometimes use different microcomputer chips and hence different disk

	controller chips, and understanding that such differences necessitate unique disk operating systems among manufacturers.
	2. Studying the commonalities among DOS versions including programs to keep a record of 1) where files are stored on the floppy disk; 2) where the file will be loaded into computer memory; and 3) when the information will be exchanged between disk drive and computer.

2.2 On a written test, students will demonstrate their knowledge of the handling of diskettes and other magnetic storage devices by listing the necessary safety precautions.

Subject Matter Content	Learning Activities
Disk Handling	1. Reviewing the property of magnetic materials including magnetic tapes and diskettes.
	2. Studying the parts of a 5 1/4 inch floppy diskette.
	3. Adhering to the safe handling procedures recommended by manufacturers and classroom study.

2.3 In an exercise to create a copy of a master diskette, students will use the backup utility program and be able to distinguish utility programs from DOS programs.

Subject Matter Content	Learning Activities
Disk Backup and Utilities	1. Performing a backup of a master disk by following on-screen instructions.
	2. Verifying the accuracy of a backup disk by performing a cold boot with the disk.

3. Explaining how utilities differ from system programs for a unit test.

3.1 On a written test, students will demonstrate their knowledge of application software by distinguishing it from system software.

Subject Matter Content	Learning Activities
Application Software	1. Examining examples of application software such as word processors, computer aided drafting (CAD) systems, and electronic spreadsheets. 2. Differentiating between application programs and DOS for a unit test.

4.1 On a written test, students will demonstrate their knowledge of BASIC by correctly assigning values to variables using LET, INPUT, and READ statements.

Subject Matter Content	Learning Activity
BASIC - Assigning Values	Discovering the nouns of BASIC and how they are named through LET, INPUT, READ statements.

4.2 On a written test, students will demonstrate their knowledge of instructions in BASIC that manipulate data by correctly anticipating the solution to mathematical statements.

Subject Matter Content	Learning Activity
BASIC - Calculations	Working with the verbs of BASIC through mathematical computations.

4.3 On a written test, students will demonstrate their knowledge of unconditional and conditional instructions by correctly listing the sequence of statement execution in a BASIC program containing many branching opportunities.

Subject Matter Content	Learning Activity
BASIC - Loops	Providing alternative conclusions which may be based upon the value of certain variables (i.e., IF-THEN-ELSE, GOTO, GOSUB, ON K)

4.4 On a written test, students will demonstrate their knowledge of output commands by correctly using PRINT, PRINT comma, PRINT semi-colon, PRINT TAB, and other graphics features special to the computer they have available to them.

Subject Matter Content	Learning Activities
BASIC -Output	1. Demonstrating variations on computer output by using the PRINT, PRINT comma, PRINT semi-colon, PRINT TAB, and other Print command variations special to the available machine. 2. Using the graphics mode of the available machine to create differing screen images for a unit test.

5.1 On a written test, students will demonstrate their knowledge of robotic languages by correctly associating the names of manufacturers with their robotic language.

Subject Matter Content	Learning Activities
Robotic Languages	1. Examining those application programs created by the manufacturer to control his robot more easily while using, in most cases, computer hardware of another company. 2. Associating the following robot control languages with the companies distributing them: a) Armbasic-Microbot b) Robotalk-Rhino c) AML-IBM

d) ROPS-Cincinnati Milacron
e) KAREL-GMF
f) VAL-Unimation

5.2 Should the equipment be available, students will demonstrate their knowledge of a robot control language by writing a program under the direction of the instructor.

Subject Matter Content	Learning Activity
Armbasic/Robotalk	Programming the Microbot robot using Armbasic, or the Rhino XR3 using Robotalk, as directed by the instructor for a unit test.

ACTIVITY SHEET

1. Students should be able to do a cold and warm boot on the microcomputer.
2. Obtain a catalogue or directory of all files on a disk.
3. Load and execute a program as specified by the instructor.
4. Transfer files from the computer memory to the disk.
5. Turn off the microcomputer properly and store the disk correctly.
6. Correctly determine the purpose and output of a BASIC program provided by the instructor.
7. Have the robot follow a programmed sequence of instructions as determined by the teacher.

UNIT VI TEST

I. ANSWER THE FOLLOWING QUESTIONS:

1. Which program language requires the programmer to know binary and hexidecimal number systems?

2. Which programming language uses different combinations of letters and numbers to stand for binary numbers in machine language?

3. Which programming languages are English-based and have a set of vocabulary words, syntax, rules of usage, and rules of grammar?

II. TRUE OR FALSE

A. The following statements involve the names of various microcomputer manufacturers, disk operating system (DOS), and their general characteristics. Write the word TRUE or FALSE in the space provided.

_____ 1. Without the disk operating system, the computer could not communicate with the keyboard or the video screen.

_____ 2. Disk operating systems must be able to perform the same tasks a ROM-based operating system normally does.

_____ 3. One of the DOS subprograms keeps track of the space available on the disk and can printout the message "Disk Full."

_____ 4. Some of the operations controlled by DOS make use of instructions stored in ROM.

_____ 5. Apple DOS is used with Apple microcomputers and can easily be modified to work in IBM and Atari computers.

_____ 6. MSDOS and CP/M produce files that are machine independent.

_____ 7. Unix is a multi-task/multi-user DOS that requires a 16-bit microprocessor and has no viable application to education.

_____ 8. Radio Shack's TRSDOS and IBM's PCDOS are machine independent within the line of products made by their respective companies.

SECTION B: The following items involve disk handling, disk parts, and creating a backup. Answer TRUE or FALSE in the space provided.

_____ 9. Static discharge cannot harm the magnetic fields stored on a cassette or floppy disk.

_____ 10. Only use plastic paper clips to attach papers to a floppy disk. Plastic is non-magnetic.

_____ 11. Never put cassette tapes or floppy diskettes on top of tapeplayer speakers or video display sets.

_____ 12. Chalk dust can scratch data off of a floppy disk.

_____ 13. The glue and the sealers that hold the magnetic media to the surface of the floppy disk can be adversely affected by the oils from a fingerprint.

_____ 14. On a 5 1/4 inch floppy, the write protect tab must be placed over the write protect notch so as to protect the floppy disk from being written on accidentally.

_____ 15. An alignment pin is inserted into the alignment hole to verify proper disk alignment during read/write operations.

SECTION C: UTILITY PROGRAMS. Answer TRUE or FALSE.

_____ 16. BASIC is one of the most readily available utility programs.

_____ 17. Format is a utility program that records track, sector, and timing information on the disk.

_____ 18. The Backup utility may format a disk and copy all the files from another disk to that one.

SECTION D: APPLICATION VERSUS SYSTEM SOFTWARE. Answer TRUE or FALSE.

_____ 19. Application software usually desig ed to perform one specific function such as process control or robotic control.

_____ 20. System software may utilize application languages such as word processors or spreadsheets to handle data transfers to and from the disk to save programming time and disk memory.

III. BASIC COMPUTER PROGRAM

Determine the purpose of this program written in IBM's BASICA and then summarize its output.

```
10 DIM C$(10)
20 GOSUB 1000
30 CLS
40 INPUT "Input Resistor Value . . . ";R
50 IF R=0 THEN END
60 IF R<10 THEN PRINT "Value too low":GOTO 40
70 GOSUB 2000
80 PRINT "Color bands are ";C1$;" ";C2$;" ";C3$
90 PRINT : PRINT
100 INPUT "Want to do another . . . (YES/NO) ",X$
110 IF X$="YES" THEN GOTO 30
120 END
1000 REM READ COLORS
1010 FOR K=0 TO 9
1020 READ C$(K)
1030 NEXT K
1040 DATA BLACK,BROWN,RED,ORANGE,YELLOW,GREEN,BLUE,VIOLET,GRAY,WHITE
1050 RETURN
2000 REM DETERMINE VALUES
2010 IF R<100 THEN I=0:R1=R:GOTO 2060
2020 FOR I=1 TO 7
2030 IF R/10^I+.5<100 THEN GOTO 2050
2040 NEXT I
2050 R1=INT(R/10^I+.5)
2060 V1=INT(R1/10+.05)
2070 V2=R1-10*V1
2080 V3=I
2090 C1$=C$(V1)
2100 C2$=C$(V2)
2110 C3$=C$(V3)
2120 RETURN
```

UNIT VI TEST ANSWER KEY

I. (1) machine language
(2) assembly language
(3) high level languages

II. TRUE OR FALSE

1.	False	11.	True
2.	True	12.	True
3.	True	13.	True
4.	True	14.	True
5.	False	15.	False
6.	True	16.	False
7.	False	17.	True
8.	False	18.	True
9.	False	19.	True
10.	False	20.	False

III. BASIC COMPUTER PROGRAM

The BASIC program functions as a resistor color code chart. By entering in the ohm value of a given resistor, the color of each band will be acknowledged.

EVALUATION AND TESTING

Students will be evaluated by the following guidelines:

1. Completing the unit test with at least 70% accuracy.
2. Always working safely and insisting others do so also.
3. Demonstrating the ability to work cooperatively with others.
4. Demonstrating the ability to listen and comprehend.
5. Demonstrating the ability to read and comprehend.
6. Demonstrating the ability to record notes that provide accurate and complete information needed for future use.
7. Demonstrating the ability to cold and warm boot the microcomputer, distinguish among higher level languages and application languages, and transfer files to and from the disk.
8. Demonstrating the ability to program in BASIC and in an application language such as Armbasic or Robotalk.

EQUIPMENT AND SUPPLIES

The equipment listed below is by no means exhaustive. Instructors are to be guided by their experiences, preferences and budgets.

1. Selected microcomputer - one for every two students.
2. Selected robot and software.
3. Selected printer and data switch - one for every two microcomputers.
4. Selected floppy disk drives - at least one per computer.
5. Selected video monitor - at least one per computer.
6. Owner's manuals for selected equipment.
7. Supply of floppy disks for backing up programs.
8. Surge protectors as needed.
9. Selected application software such as word processors, or computer assisted drafting (CAD), etc.

BULLETIN BOARD IDEAS

To create a very effective bulletin board, one must use the skills taught in graphic communications and be thoroughly familiar with the topic displayed. For these reasons, teachers may want to encourage small student groups to design bulletin board displays. Bulletin board ideas for this unit include:

1. Coding that accomplishes the same task written in machine language, assembly language, and BASIC.
2. A flow chart of a disk operating system.

3. A detailed diagram of a floppy disk, labeling its parts and stating the do's and don't's of disk storage and handling.
4. Listings and/or graphics outputs of BASIC programs.
5. Industrial robots at work.

SUPPLEMENTARY MATERIALS

The following references may be useful in preparing to teach this course:

1) Computer Buyer's Guide C. W. Communications, Inc.
Framingham, Massachusetts 01701

2) Computer Supplies Catalogue

Wheeler Group, Inc.
Hartford, Connecticut 06104

3) Introduction to Microcomputer Application (Teacher Ed.) and Basic Microcomputer Service Technician (Teacher Ed.)

Mid-America Vocational Curriculum Consortium, Inc.
1500 West Seventh Avenue
Stillwater, Oklahoma 74074-4364

UNIT VII

INTRODUCTION TO ROBOTICS AND AUTOMATION

INTRODUCTION

We are being rapidly engrossed in a new era of industry, the age of robotics and automation. This era, like the other industry milestones, will bring us much capability, efficiency, and ultimately, happiness. However, this new technology can be of serious negative consequence if not used appropriately.

This unit will trace the history of robotics, arrive at a logical definition of what a robot is, and cogitate the techniques of automation thus giving us a conceptual image of the appropriate use of robots.

COMPETENCIES

1. To be able to trace through the history of robotics.
2. To write the definition of a robot, and define the terms used in the definition.
3. To distinguish the similarities and differences of fixed versus flexible automation.

GENERAL PERFORMANCE OBJECTIVES/GOALS

1. To be able to trace through the history of robotics. Knowing the historically significant milestones in the field of robotics.
2. To write the definition of a robot, and define the terms used in the definition. Identify the appropriate robot applications.
3. To distinguish the similarities and differences of fixed versus flexible automation. Knowing the appropriate utilization of fixed automation, in comparison to the use of robots.

SPECIFIC PERFORMANCE OBJECTIVES AND MASTERY CRITERIA

1.1 On a written test, students will be able to demonstrate knowledge of the Greek epic on Hephaestus.

1.2 On a written test, students will be able to explain the significance of the 1893 circa George Moore's "walking locomotive".

1.3 On a written test, students should be able to demonstrate their knowledge 1950 circa Planet Corp's "practical robot" and the Unimation robots of 1961.

1.4 On a robot demonstrator students should be able to define the differences between today's industrial robots and science fiction's, R2D2, and other anthropomorphic robot forms.

1.5 On a written test, students should be able to demonstrate their knowledge of the reasons why the Japanese have a world lead in robotics.

2.1 On a written test, students should be able to demonstrate their knowledge of the definition of a robot from the Robotics Institute of America.

2.2 On a written test, students should be able to explain the Society of Manufacturing Engineers' definition of a robot. Furthermore, they should be able to distinguish how these definitions vary from the common concept of anthropomorphic robots.

3.1 On a written test, students should define the two major types of manufacturing, continuous process versus batch or mass production manufacturing systems.

3.2 On a written test, students will be able to demonstrate knowledge of the two techniques of Automation. Define hard automation and flexible automation.

METHODOLOGY

The methodology used in this unit will be to make the student familiar with the history of robotics. The student will also be able to arrive at a logical definition of what a robot is, and to cogitate the techniques of automation thus giving the student a conceptual image of the appropriate use of robots.

SUGGESTED APPROACH

The extensive use of audio visual media is highly recommended. Sample transparency sheets are attached in the appendices. Furthermore, visiting an automation or continuous manufacturing plant will assist in the cogitation of the subject matter.

UNIT VII OUTLINE

INTRODUCTION TO ROBOTICS AND AUTOMATION

1. History of robotics
   a. Greek epics on Hephaestus
   b. George Moore's "walking locomotive",1893s
   c. Planet Corp's "practical robot", 1950s

d. Unimation robots, 1961.
e. Science fiction, R2D2, and other anthropomorphic
f. Japanese lead in robotics, 1978s

2. Definition of a robot
   a. explanations, classifications and definitions from the Robotics Institute of America (RIA) and Society of Manufacturing Engineers (SME).

3. Automation-fixed versus flexible
   a. continuous process versus batch and mass production
   b. application examples of both types.

SPECIFIC PERFORMANCE OBJECTIVES

1.1 On a written test, students will be able to demonstrate knowledge of the Greek epic on Hephaestus.

Subject Matter Content	Learning Activities
Greek epic on Hephaestus	1. Examine Greek mythology of machines which resembled humans. 2. Review the early civilization defining the anthropom. phic machines.

1.2 On a written test, students will be able to explain the significance of the 1893 circa George Moore's "walking locomotive".

Subject Matter Content	Learning Activities
1893 circa George Moore's "walking locomotive"	1. Examine the early steam powered self-propelled robot. 2. Review the concept of robots for military advantage. 3. Identify the limitations of these robots, having no microprocessor controllers, lack of sensor ability, etc.

1.3 On a written test, students should be able to demonstrate their knowledge of the 1950 circa Planet Corp's "practical robot" and the Unimation robots of 1961.

Subject Matter Content	Learning Activities
1950 circa Planet Corp's "practical robot" and the Unimation robots of 1961	1. Identify practical robots and the use of electronic controls. 2. Review the purpose of using robots for inhumane working conditions. 3. Define analog computers and their shortcomings.

1.4 On a robot demonstrator students should be able to define the differences between today's industrial robots and science fiction's, R2D2, and other anthropomorphic robot forms.

Subject Matter Content	Learning Activities
Today's industrial robots and science fiction's R2D2 and other anthropomorphic robot forms	1. Examine an industrial robot and compare to fiction's R2D2 and other anthropomorphic robot forms. 2. Demonstrate, using an educational robot, list the differences between a science fiction robot and an industrial robot. 3. Review the current status of robotics in actual applications and the fictional robots.

1.5 On a written test, students should be able to demonstrate their knowledge of the reasons why the Japanese currently have a world lead in robotics.

Subject Matter Content	Learning Activities
Japanese having a world lead in robotics applications	1. Examine the reasons for the Japanese lead in robotics applications. 2. Define the concepts of worker security and management approach of the Japanese manufacturing industry. 3. Review the long term commitment of Japanese manufacturers.

2.1 On a written test, students should be able to demonstrate their knowledge of the definition of a robot from the Robotics Institute of America (RIA).

Subject Matter Content	Learning Activities
Definition of robots from RIA	1. Learn the definition of robots as adopted by the RIA. 2. Examine the activities of the RIA.

2.2 On a written test, students should be able to explain the Society of Manufacturing Engineers' (SME) definition of a robot. Furthermore, they should be able to distinguish how these definitions vary from the common concept of anthropomorphic robots.

Subject Matter Content	Learning Activities
SME's definition of a robot	1. Learn the SME definition of robots. Distinguish and compare how SME varies from RIA's definitions. 2. Distinguish the difference between the RIA and SME concept of anthropomorphic robots. 3. Examine the similarities and distinguishing characteristics of these definitions and the popular belief in anthropomorphic robots.

3.1 On a written test, students should define the two major types of manufacturing, continuous process versus batch or mass production manufacturing systems.

Subject Matter Content	Learning Activities
Two types of manufacturing: Continuous process and batch/mass production	1. Examine manufacturing systems, as related to the process flow, and lot size. 2. Point out the existing techniques for automation in the above.

3.2 On a written test, students will be able to demonstrate knowledge of the two techniques of Automation. Define hard automation, define flexible automation.

Subject Matter Content	Learning Activities
The two techniques of automation, hard automation and flexible automation	1. Pointing out the similarities of the two techniques of automation, flexible and fixed. 2. Travel to a manufacturing location using automation.

ACTIVITY SHEET

1. Have students construct a written time line in their notebooks on the technological advances of industrial robots.

2. Students could build models of two or three axis movement robots.

3. Have students take any manufactured product and trace the production steps that one needed to produce the product. Once that is accomplished have students determine where robots would fit in.

4. Instructor should write or call the Robotics Institute of America (RIA) or the Society of Manufacturing Engineers (SME) to obtain pertinent information on robotics that can be given to the students.

5. If at all possible, take a field trip to a local manufacturing or processing plant to view automation techniques used.

UNIT VII TEST

1. Historically, one of the first robots documented is related to the epics concerning:
   a. Nero
   b. Plato
   c. Hephaestus
   d. Abacus

2. These robots are called _____ type robots.

3. The walking locomotive by Moore was powered by _____ _____ .

4. Moore's robot was designed for the:
   a. Automotive industry
   b. Radioactive device industry
   c. Material handling industry
   d. Military industry.

5. List three of the major limitations of these robots?

6. In this country, the first robot company to manufacture an industrial robot was:
   a. IBM
   b. Unimation
   c. General Motors
   d. Ford

7. These robots had _____ controls.

8. The purpose of these robots was to replace humans in location where the working conditions were:
   a. Highly repetitive
   b. Highly complex functions
   c. Dangerous
   d. none of the above.

9. There are two main types of robots. One is a hobby/educational type. The other is a _____ type robot.

10. Robots in the future will have the following capabilities:
    a. vision
    b. artificial intelligence
    c. all of the above
    d. none of the above.

11. List three reasons for the Japanese having a world lead on the use of robots.

12. In the RIA definition fill in the blanks:
    A robot is a _____, and _____ _____ manipulator designed to move materials, parts or specialized devices through variable programmed motions for the performance of a variety of tasks.

13. Give two examples of continuous manufacturing.

14. Give two examples of batch/mass production.

15. Most often, flexible automation is suited for:
    a. continuous manufacturing. b. batch/mass production.
    c. custom manufacturing d. none of the above.

UNIT VII TEST KEY

1. c (Hephaestus)

2. anthropomorphic

3. steam

4. d (Military)

5. a) programmability
   b) sensors
   c) functional ability

6. b (Unimation)

7. Electrical & electronic

8. c (dangerous work conditions)

9. industrial

10. c (all of the above)

11. a) management commitment
    b) high school & university emphasis on high technology
    c) near term interests of many other industrialized nations.

12. reprogrammable
    multifunctional

13. oil/gas processing
    pharmaceutical

14. automobile
    television/VCR

15. b (batch/mass production)

EVALUATION AND TESTING

1. Completing the unit test with at least 70 percent accuracy.
2. Demonstrate the ability to list the short and long-term realities of robotics.
3. Demonstrate the two distinguishing characteristics of anthropomorphic robots from industrial robots.
4. Demonstrate the international awareness of the reasons for the Japanese lead in robotics

EQUIPMENT AND SUPPLIES

1. Educational robot. Suggest: Rhino XR3 or Microbot Teachmover.
2. Textbook and supplementary materials for students and teacher.

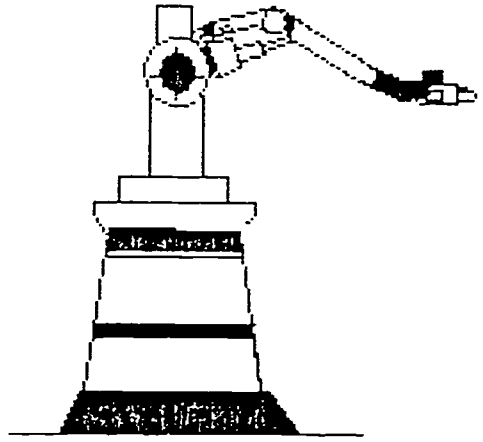
BULLETIN BOARD IDEAS

1. Obtain and affix posters of the historical robots.
2. Obtain and affix posters of modern industrial robots.
3. Obtain and affix posters of educational robots.

SUPPLEMENTARY MATERIALS

1. Borrow/purchase films from robot manufacturers.
2. Borrow/purchase periodicals from RIA or SME.
3. Make transparencies from the above periodicals.

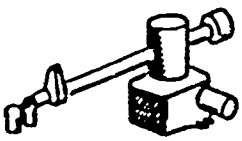
WHAT IS A ROBOT?



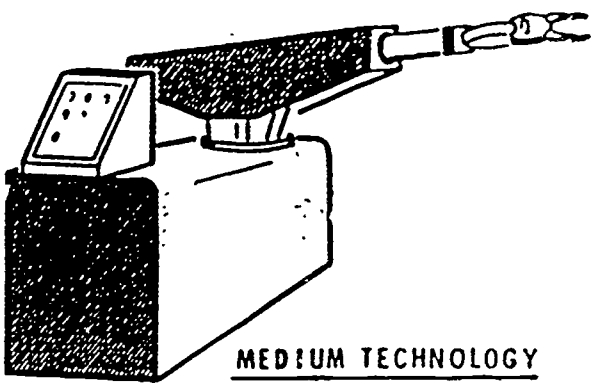
A robot has been defined as:

"... programable, multifunction manipulators designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks."

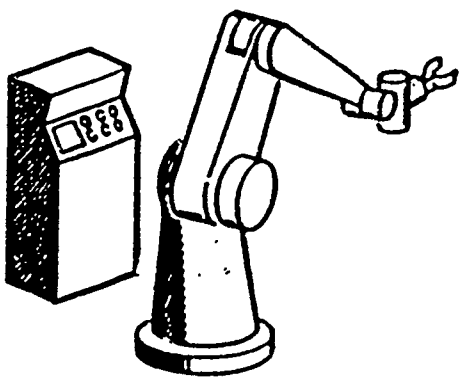
GEORGE MOORE'S WALKING LOCOMOTIVE, 1893.



LOW TECHNOLOGY
(PICK AND PLACE)



MEDIUM TECHNOLOGY
(LIMITED APPLICATION)



HIGH TECHNOLOGY
(UNIVERSAL)

TYPES OF INDUSTRIAL ROBOTS.

UNIT VIII

CLASSIFICATION OF ROBOTS

INTRODUCTION

With the successful completion of the previous chapter on the introduction to robots, we are now able to study the field of robotics in greater detail. In this chapter we will be considering the robot itself, with special emphasis on the types of robots, how to energize them and how to control the robot. We will also be considering how robots are being applied. Therefore, we will be able to spend a greater portion of our time in the laboratory, using the educational robot.

COMPETENCIES

1. Identify the typical robot components.
2. Define the different types of robots by their work envelope.
3. Select the appropriate power system for a specific robot application.
4. Recognize the various control systems used in robotics.

GENERAL PERFORMANCE OBJECTIVES/GOALS

1. Identify typical robot components, thus be able to recognize an automation machine in relation to a robot.
2. Recognize and define the different types of robots by their work envelope. Therefore, the student will be able to match the correct type of robot for the appropriate application.
3. Demonstrate knowledge of the appropriate power system in a specific robot application. This will augment the knowledge listed above.
4. Understand the various control systems used in automation, specifically in robotic control.

SPECIFIC PERFORMANCE OBJECTIVES AND MASTERY CRITERIA

1.1 On the robot demonstrator the student should be able to correctly identify the various robot components. Furthermore, on an written test the student will be able to demonstrate the various robot components.

1.2 On a written test student will be able to define the purpose and function of robot manipulators.

1.3 On the robot demonstrator the student should be able to correctly identify the robot components tooling and grippers.

2.1 On the robot demonstrator the student should be able to correctly identify the work envelope of the robot. Furthermore, on a written test the student will be able to demonstrate knowledge of the various robot work envelopes.

2.2 On a written test student will be able to define the purpose and function of a cylindrical coordinate robots.

2.3 In an exercise, student will be able to draw the work envelope and define the purpose and function of a spherical (polar) coordinate robot.

2.4 On a written test student will be able to define the purpose and function of a jointed spherical arm (articulating) robot.

3.1 On the robot demonstrator the student should be able to correctly identify the power system of the robot.

3.2 On a written test student will be able to define the purpose and function of pneumatic robots.

3.3 On the robot demonstrator, the student should be able to correctly identify the advantages of a electrically powered robot.

3.4 On a written test student will be able to define the purpose, function and advantages of a hydraulically-powered robot.

4.1 On the robot demonstrator the student should be able to correctly identify the control system of the robot.

4.2 On a written test student will be able to define the purpose and function of servo and nonservo robots.

4.3 On a written test student will be able to define the purpose, function and advantages of a robot with a continuous path.

4.4 On a written test student will be able to define the purpose and function of Programmable Logic Controllers (PLC) in robotics.

4.5 On the robot demonstrator the student should be able to correctly identify the controller of the robot. Furthermore, the student should be able to define the uses of Mainframe, mini and micro computers for controlling robots.

METHODOLOGY

The methodology used in this unit will be to make the student familiar with the classifications of robotics. The

student will also be able to practice on a laboratory robot to arrive at logical definitions cf work envelopes. Further experimentation and visitation at a power/auto laboratory will assist the student in understanding electric, pneumatic and hydraulic power systems.

SUGGESTED APPROACH

The extensive use of audiovisuals is highly recommended. Sample transparency sheets are attached in the appendices. Furthermore, visiting an automation or continuous manufacturing plant will assist in the cogitation of the subject matter. The student learning will be increased by the extensive demonstration and experimentation with the laboratory robot.

UNIT VIII OUTLINE

CLASSIFICATIONS OF ROBOTS

A. Robot components
   1. manipulators
   2. tooling and grippers
   3. appendages with axis of movement

B. Work envelope
   1. cylindrical coordinate robots
   2. spherical (polar) coordinate robots
   3. jointed spherical arm (articulating) robots

C. Power systems
   1. pneumatic powered robots
   2. hydraulic powered robots
   3. electric robots

D. Control Systems
   1. servo and nonservo
   2. point to point
   3. continuous path
   4. Programmable Logic Controllers (PLC)
   5. Mainframe, mini or micro control

SPECIFIC PERFORMANCE OBJECTIVES

1.1 On the robot demonstrator the student should be able to correctly identify the various robot components. Furthermore, on a written test the student will be able to demonstrate the various robot components.

Subject Matter Content	Learning Activities
Robot components	1. Examine the different robot components. 2. Review the relationship to anthropomorphic robots. 3. Experiment with moving the various parts of the robot. 4. Simulate the operation of an industrial robot.

1.2 On a written test student will be able to define the purpose and function of robot manipulators.

Subject Matter Content	Learning Activities
Robot manipulators	1. Examine the various types of robot manipulators. 2. Experiment with the laboratory robot's manipulators.

1.3 On the robot demonstrator the student should be able to correctly identify the robot components, tooling, and grippers.

Subject Matter Content	Learning Activities
Robot grippers and tooling	1. Identify the robot's end of arm tooling. 2. Define other types of tooling for various applications.

2.1 On the robot demonstrator the student should be able to correctly identify the work envelope of the robot. Furthermore, on a written test the student will be able to demonstrate knowledge of the various robot work envelopes.

Subject Matter Content	Learning Activities
Work envelope and robot type	1. Demonstrate the work envelope of the laboratory robot. 2. Review the different work envelopes of industrial robots.

2.2 On a written test student will be able to define the purpose and function of a cylindrical coordinate robot.

Subject Matter Content	Learning Activities
Cylindrical coordinate robots	1. Examine the work envelope of a cylindrical coordinate robot. 2. Review applications of a cylindrical coordinate robot. 3. Experiment with the laboratory robot, simulating a cylindrical coordinate

2.3 In an exercise, student will be able to draw the work envelope and define the purpose and function of a spherical (polar) coordinate robot.

Subject Matter Content	Learning Activities
Spherical coordinate robots	1. Examine the work envelope of a spherical coordinate robot. 2. Review applications of a spherical coordinate robot. 3. Experiment with the laboratory robot, simulating a spherical coordinate robot.

2.4 On a written test student will be able to define the purpose and function of a jointed spherical arm (articulating) robot.

Subject Matter Content	Learning Activities
Jointed spherical arm robots	1. Examine the work envelope of a jointed spherical arm robot. 2. Review applications of a jointed spherical arm robot. 3. Experiment with the laboratory robot, simulating a jointed spherical arm robot.

3.1 On the robot demonstrator the student should be able to correctly identify the power system of the robot.

Subject Matter Content	Learning Activities
Power systems for energizing the robot	1. Demonstrate the power system of the laboratory robot. 2. List three major advantages of these power systems.

3.2 On a written test the student should be able to define the purpose and function of a pneumatic robot.

Subject Matter Content	Learning Activities
Purpose and function pneumatic robots	1. Demonstrate the use of of pneumatic robots. 2. Define three major advantages of pneumatic robots.

3.3 On the robot demonstrator the student should be able to correctly identify the advantages of an electrically powered robot.

Subject Matter Content	Learning Activities
Electric robots	1. Review the advantages of electric robots. 2. Identify the types of electric motors used in robotics.

3.4 On a written test the student should be able to define the purpose, function, and advantages of a hydraulically-powered robot.

Subject Matter Content	Learning Activities
Purpose and function of hydraulic robots	1. Demonstrate the use of of hydraulic robots. 2. Define three major advantages of hydraulic robots.

4.1 On the robot demonstrator the student should be able to correctly identify the control system of the robot.

Subject Matter Content	Learning Activities
Control systems	1. Examine the purpose of control systems. 2. Experiment with the control system of the laboratory robot's control system.

4.2 On a written test the student should be able to define the purpose and function of servo and nonservo robots.

Subject Matter Content	Learning Activities
Nonservo and servo controls	1. Review nonservo controls. 2. Define servo controls. 3. Identify point to point robots with the above types of control.

4.3 On a written test the student should be able to define the purpose, function, and advantages of a robot with a continuous path movement.

Subject Matter Content	Learning Activities
Continuous path robot	1. Review continuous path robot control. 2. Identify industrial applications of robots with the above types of control.

4.4 On a written test the student should be able to define the purpose and function of Programmable Logic Controllers (PLC) in robotics.

Subject Matter Content	Learning Activities
PLC devices	1. Compare PLC to computers. 2. Examine PLC internal features. 3. Define PLC in robot control.

4.5 On the robot demonstrator the student should be able to correctly identify the controller of the robot. Furthermore, the student should be able to define the uses of Mainframe, mini and micro computers for controlling robots.

Subject Matter Content	Learning Activities
Mainframe, mini or micro computer control of the robot.	1. Define the control strategies for controlling robots. 2. Examine hierarchical control structure of robot controlling. 3. Define the robot control structure of robot controlling.

ACTIVITY SHEET

1. Experiment with moving the various parts of the robot.

2. Experiment with the laboratory robot's manipulators.

3. Demonstrate the work envelope of the laboratory robot.

4. Experiment with the laboratory robot, simulating a cylindrical coordinate robot.

5. Experiment with the laboratory robot, simulating a spherical coordinate robot.

6. Experiment with the laboratory robot, simulating a jointed spherical arm robot.

7. Experiment with the control system of the laboratory robot's control system.

ACTIVITY SHEET KEY

1. The student should be cognizant of the robot components via moving the various parts of the robot.

2. The student should be able to define the laboratory robot's manipulators.

3. The student should be knowledgeable of the work envelope of the laboratory robot.

4. The student should be cognizant of the laboratory robot, simulating a cylindrical coordinate robot.

5. The student should be able to simulate the laboratory robot, to be a spherical coordinate robot.

6. The student should be cognizant of the laboratory robot, simulating a jointed spherical arm robot.

7. The student should be cognizant of the control system of the laboratory robot.

UNIT VIII TEST

1. The three basic robot components are:

   a. _____

   b. _____

   c. _____

2. Considering a pick and place robot to a science fiction type anthropomorphic robot, one can see that they are closely related.

   a. true b. false

3. Define the purpose of the robot manipulator.

4. Typically the base of the robot is fixed to the floor. Sometimes though, it may be:
   a. moving on a conveyer
   b. mounted on a roof gantry
   c. both of the above
   d. none of the above

5. Which work envelope of the following robot type most closely resembles humans.
   a. cylindrical b. pick and place
   b. jointed cylindrical d. jointed arm

6. The device connected to the robot wrist is called the end effector. It can also be called the _____.

7. The robot which most closely resembling a tank turret is:
   a. cylindrical b. jointed cylindrical
   c. spherical coordinate d. none of the above

8. The end effector is designed to meet the needs of the robot _____ ?
   a. power supply b. motion
   c. application d. control

9. The _____ is responsible for moving the end effector to the programmed locations.

10. Define work envelope.

11. The robot center control technique is to use a:
    a. mainframe computer b. air logic computer
    c. both of the above d. none of the above

12. The end effector must be flexible enough as to be retrofited to other tasks, with out major redesign.
a. true b. false

13. When the movement of the manipulator is done using a pressurized fluid, what is the energy called?

14. When heavy payloads are encountered, _____ type of energy is used to power the robot.

15. A robot which is of the pick and place type will have an end effector called a _____.

16. When adding an end effector, the work envelope of a robot will:
a. increase
b. decrease
c. depends on the end effector
d. none of the above

17. The time required in a programmable controller to completely execute its program will typically be:
a. a fraction of a second
b. few seconds
c. few minutes to many hours
d. none of the above

18. Two major classifications of end effectors are
a. vacuum and electric
b. mechanical and vacuum
c. grippers and end of arm tooling
d. none of the above

19. In a spot welding application, the most appropriate robot would be a point to point robot.

a. true b. false

20. In a spray painting application, the most appropriate robot would be a point to point robot.

a. true b. false

UNIT VIII TEST KEY

1. a. Manipulator b. Controller c. Power Source
2. false
3. The manipulator does the physical work of the robot.
4. 3. both of the above
5. d. jointed arm
6. gripper or end of arm tooling
7. c. spherical coordinate
8. c. application
9. manipulator
10. The work envelope is the total area that the robot can reach.
11. c. none of the above
12. a. true
13. pneumatic energy
14. hydraulic
15. gripper
16. a. increase
17. a. fraction of a second
18. c. grippers and end of arm tooling
19. a. true
20. b. false

EVALUATION AND TESTING

Students will be evaluated by the following guidelines:

1. By completing the unit test with at least 70% accuracy.
2. Demonstrate the ability to recognize the different classifications of robots.
3. Demonstrate the ability to distinguish the uses of the three power control systems used in robotics.
4. Demonstrate resourcefulness in identifying the different types of robots by their work envelope.
5. Actively participate in a class discussion on robot components.

EQUIPMENT AND SUPPLIES

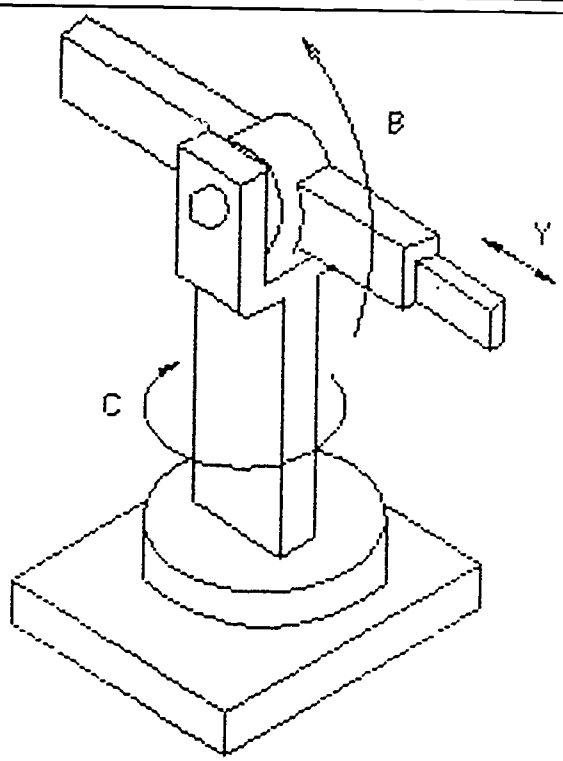
1. Educational Robot. Suggest either the Rhino XR3 or Microbot Teachmover.
2. Microcomputer. Suggest either the IBM PC or Apple IIe.
3. Workcell components purchased from Rhino, Microbot or laboratory made.
4. Obtain different end effectors for either of the above robots.
5. Robotics textbook and robotics periodicals.

BULLETIN BOARD IDEAS

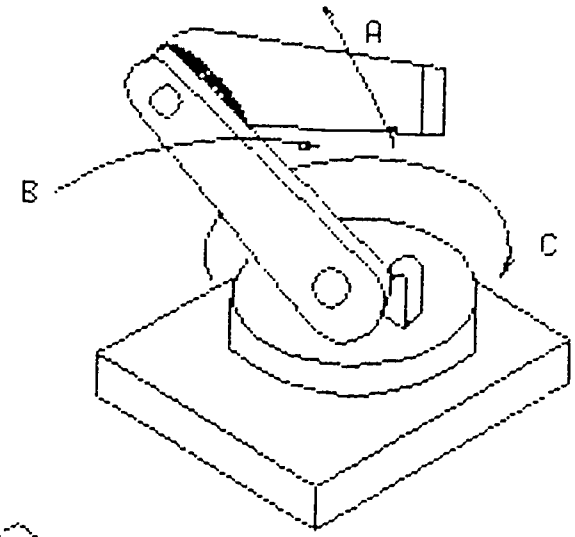
1. Write to industrial robotic manufacturers for posters.
2. Have students collect robotic articles from newspapers and magazines.
3. Have drafting classes draw different types of end effectors.

SUPPLEMENTARY MATERIALS

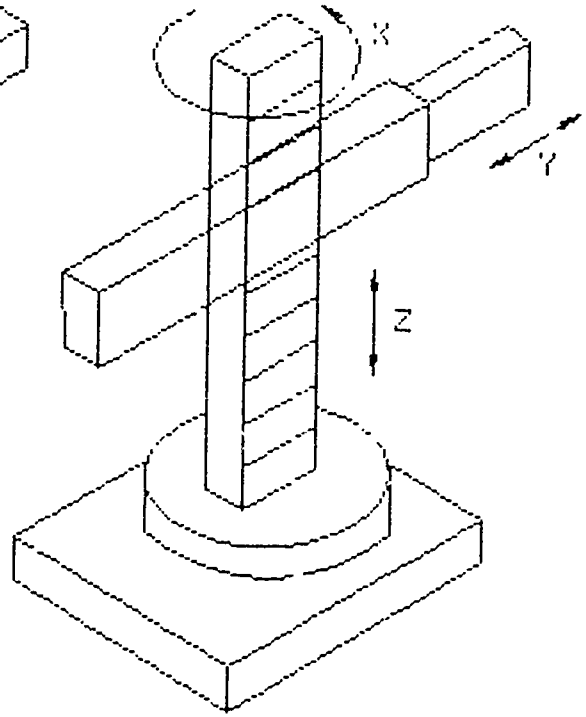
1. Borrow films or video cassettes from robotic manufacturers.
2. Subscribe to robotic periodicals such as ROBOTICS WORLD, ROBOTICS TODAY, and ROBOTICS ENGINEERING.
3. Obtain transparencies from RIA or SME.



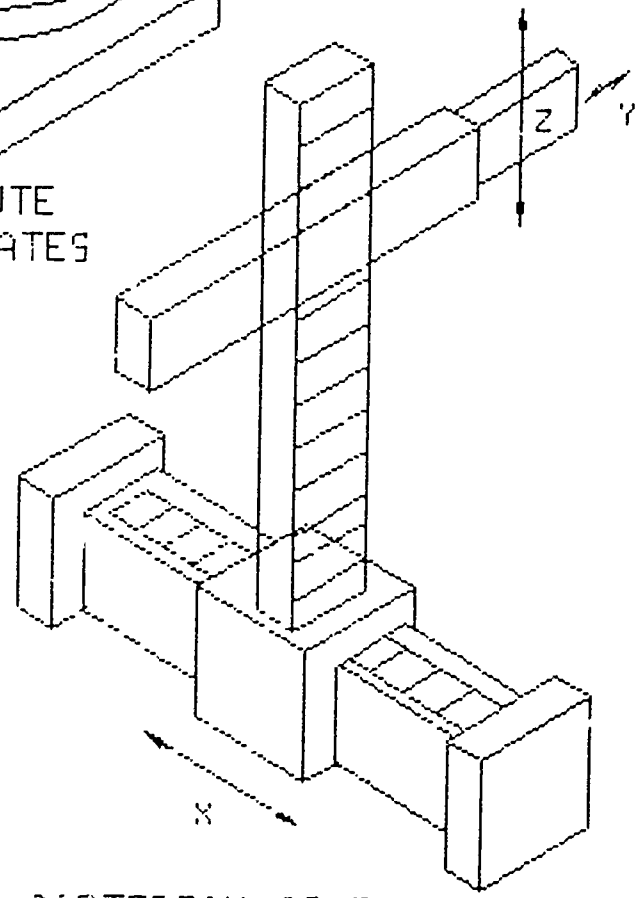
POLAR
COORDINATES



REVOLUTE
COORDINATES



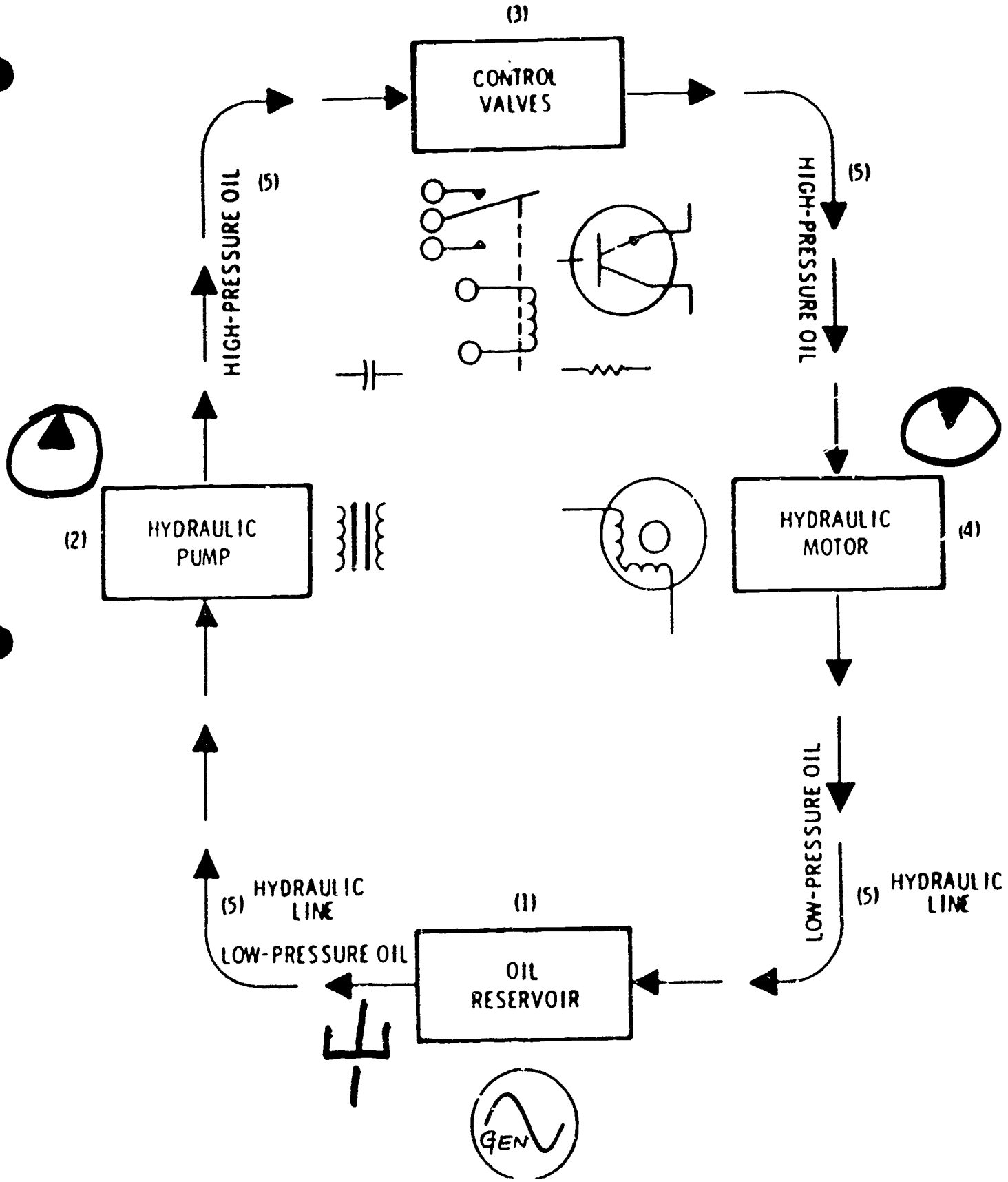
CYLINDRICAL COORDINATES



CARTESIAN .COORDINATES

TYPES OF ROBOTS AND THEIR CHARACTERISTICS

CATEGORIES	ELECTRO MECHANICAL	HYDRAULIC	PNEUMATIC
LOAD	GENERALLY SMALL	LARGE	LARGE
PRESSURE	--- --- ---	500-600 PSI	LOW
CONTROL	EXCELLENT, BUT DEPENDS ON TYPE OF MOTOR	VERY GOOD	GOOD IF MOVEMENT AND CIRCUIT ARE SMALL; CONTROL DROPS AS DISTANCE OF LINE INCREASES
MODE	SERVO OR NON-SERVO	SERVO OR NON-SERVO	SERVO OR NON-SERVO



BASIC HYDRALLIC SYSTEM

UNIT IX

INTERFACING

INTRODUCTION

This unit will cover the concepts involved with interfacing a robot system to a microcomputer. Since we have cogitated the basic robot, how we power it, and how we control it in the pervious chapter, we are now ready to implement a robot system. Thus the emphasis of this chapter will be to interface the robot and make it detect the presence of physical phenomenon.

COMPETENCIES

1. To be cognizant of robot safety.
2. To be able to identify the techniques of interfacing a robot to a microcomputer.
3. To be able to identify the techniques of interfacing sensors to robotics systems.

GENERAL PERFORMANCE OBJECTIVES/GOALS

1. Understanding the significance of the safety factors when working with an industrial robot.
2. To identify and define the techniques of interfacing a robot to a microcomputer.
3. To be able to define the appropriate sensors used in a laboratory robotics system, such that it will be capable of functioning as an industrial robot.

SPECIFIC PERFORMANCE OBJECTIVES AND MASTERY CRITERIA

1.1 Understanding the safety of a robot system, including the tagging of circuits being serviced, awareness of wet conditions, cable condition, gasses near batteries, use of the "one-hand-rule", condition of test equipment, following OSHA regulations, purpose of interlocks and other safety switches, use of medications, casual clothing, and protective clothing.

2.1 In a written examination, the student should be able to recognize the interface boards and ports used in robotics.

2.2 In a laboratory exercise, the student should be able to recognize the interface ports and boards used in robotics.

2.3 In an electrical schematic, the student should be able to follow the protocol management of computer communications.

2.4 In a written examination, the student should be able to define certain significant protocol standards used in industrial robot communications.

2.5 In a written examination, the student should be able to recognize the interface standards used in industrial robotics.

3.1 Using the laboratory robot, the student should be able to identify sensors.

3.2 In a written test the student should be able to identify and explain an application for the most commonly used robot sensors: Optical sensors, robot vision, Tactile sensing, Voice recognition, Proximity sensors, Temperature, Pressure and velocity sensors.

METHODOLOGY

The methodology used in this unit will be to make the student familiar with the interfacing of robotics. The student will also be able to practice on the laboratory robot to arrive at logical definitions of interface standards. Further experimentation and visitation at a power/auto laboratory will assist the student in understanding the applications of sensors, and the interfacing techniques.

SUGGESTED APPROACH

The extensive use of audiovisuals is highly recommended. Sample transparency sheets are attached in the appendices. Furthermore, visiting an automation or continuous manufacturing plant will assist in the cogitation of the subject matter. The student learning will be increased by the extensive demonstration and experimentation with the laboratory robot.

UNIT IX OUTLINE

INTERFACING

A. Safety

B. Microcomputer interfaced to a robot
   1. Interfacing ports and boards
   2. Protocol management
   3. Interface standards

C. Sensors
   1. Optical sensors and robot vision interfacing
   2. Tactile sensing
   3. Voice recognition
   4. Proximity sensors
   5. Temperature, Pressure and velocity sensors

SPECIFIC PERFORMANCE OBJECTIVES

1.1 Understanding the safety of a robotics system, including the tagging of circuits being serviced, awareness of wet conditions, cable condition, gasses near batteries, use of the "one-hand-rule", condition of test equipment, following OSHA regulations, purpose of interlocks and other safety switches, use of medications, casual clothing, and protective clothing.

Subject Matter Content	Learning Activities
Safety	1. Examine the safety concepts of robotics. Review the relationship of electronics to power systems safety.

2.1 In a written examination, the student should be able to recognize the interface boards and ports used in robotics.

Subject Matter Content	Learning Activities
Interface boards/ports	1. Examine the various types of interface ports including input ports and output ports. 2. Examine the various types of interface circuits, including the asynchronous, synchronous, and Large Scale Integration (LSI) circuits.

2.2 In a laboratory exercise, the student should be able to recognize the interface ports and boards used in robotics.

Subject Matter Content	Learning Activities
Laboratory robot's interface boards/ports	1. Examine the various types of interface boards and ports available on the laboratory robot.

2.3 and
2.4 Using an electrical schematic in a written examination, the student should be able to follow the protocol management of computer communications.

Subject Matter Content	Learning Activities
Protocol management	1. The examination of the purpose for protocols 2. The review of synchronous communications protocol. 3. The defining of the layered protocols, including Manufacturing Automation Protocol (MAP).

2.5 In a written examination, the student should be able to recognize the interface standards used in industrial robotics.

Subject Matter Content	Learning Activities
Interface standards	1. Examine and be cognizant of the RS 232C, RS 422 and IEEE 488 interface connections.

3.1 Using the laboratory robot, the student should be able to identify any sensors used.

Subject Matter Content	Learning Activities
Sensors used on the laboratory robot	1. Demonstrate the use of sensors on the laboratory robot. 2. Experiment with other types of sensors. Compare to anthropomorphic and science fiction robots.

3.2 On a written test the student should be able to identify and explain an application for the most commonly used robot sensors: Optical sensors, robot vision, Tactile sensing, Voice recognition, Proximity sensors, Temperature, Pressure and velocity sensors.

Subject Matter Content	Learning Activities
Sensors	1. Understanding the principle of operation, the capabilities and the applications of industrial robot sensors.

ACTIVITY SHEET

1. Have students demonstrate the techniques of safety when working with a robotics system.

2. Have students examine the various types of interface boards/ports that are available on the laboratory robot.

3. Students should demonstrate the use of sensors on a laboratory robot.

4. Have students experiment with other types of sensors.

ACTIVITY SHEET KEY

1. The student should be cognizant of the various safety aspects on the laboratory robot. Furthermore, the student should be able to relate this information to an industrial robotics application.

2. The student should be able to define the various interface circuits, and be able to interface the laboratory robot to a microcomputer. The student also should be able to determine the capabilities and limitations of interfacing.

3. At the end of the laboratory experience, the student should be able to interface sensors to the robot. The students also should be cognizant of the other types of sensors found in industrial applications.

UNIT IX TEST

1. When working with industrial electrical systems, circuits that are being serviced must be
   a. tagged
   b. locked open
   c. both of the above
   d. none of the above

2. Define a purpose for an interfacing board.

3. It is important to beware of gasses being produced by batteries because they can be toxic and explosive.
   a. true
   b. false

4. Two of the most fundamental interface ports are:
   a. ASCII and BCD ports
   b. A and B ports
   c. input and output ports
   d. none of the above

5. A communications protocol is a set of rules governing information flow in a synchronous data communications system.
   a. true
   b. false

6. When working with live line voltages, it is prudent to have both hands touching the equipment simultaneously.
   a. true
   b. false

7. The two major classifications of robot sensors are
   a. fast and slow
   b. electric and hydraulic
   c. contact and noncontact
   d. none of the above

8. A Charged Coupled Devices (CCD), will convert light images from a picture to electric signals.
   a. true
   b. false

9. Define NEMA.

10. Define three safety features used on test equipment and their electrical leads.

11. The purpose of the input port is to channel information (computer data) from the computer to the robot system.
    a. true
    b. false

12. A layered protocol will:
    a. handle communications networks
    b. specify physical to applications layers
    c. be similar to MAP protocols
    d. all of the above

13. As related to RS 232C, a mark is a:
    a. voltage more negative than 3 V
    b. a logic high
    c. both of the above
    d. none of the above

14. Define the application of sensors used in robotics.

15. It is permissible to override interlocks and safety switches, as long as one knows what they are doing, and make a solemn promise to be careful.
    a. true b. false

16. As long as the doctor knows about the medicine, it will be permissable to use mind altering drugs while working with robot equipment.
    a. true b. false

17. One needs to keep to the company dress code. Thus it is permissable to wear loose and floppy clothes near a industrial robotics system.
    a. true b. false

18. The IEEE 488 bus standard is:
    a. also called the GPIB bus standard
    b. bit parallel
    c. capable of managing up to 15 devices
    d. all of the above

19. A _____ is a basic temperature sensing device.

20. The purpose of the output port is to channel information (computer data) from the computer to the robot system.
    a. true b. false

21. Name the most common/popular digital communications standard.

22. As related to RS 232C, a space is a:
    a. voltage more negative than 3 V
    b. a logic high
    c. both of the above
    d. none of the above

23. The advantages of the RS 422 over the RS232C:
    a. balanced data transmission
    b. less susceptible to stray fields
    c. higher baud rates
    d. all of the above

24. Define LSI.

25. Give three examples of sensors used in robotics.

UNIT IX TEST KEY

1. c. both of the above

2. An interfacing board is used for communication between the computer, robot system and peripheral devices.

3. a. true

4. c. input and output ports

5. a. true

6. b. false

7. c. contact and non contact

8. a. true

9. National Electric Manufactures Code. Designs and set electrical standards. Known for internationally accepted electrical safety rules.

10. Test equipment must be: a) in good working order, b) worn leads must be replaced, c) connections must be checked regularly, d) only exact replacements must be used for damaged components, e) verify that the ground connection is intact.

11. b. false

12. d. all of the above

13. c. all of the above

14. Sensors are used for the robot to evaluate its environment. It may need to touch, see, and hear.

15. b. false

16. b. false

17. b. false

18. d. all of the above

19. thermocouple

20. a. true

21. RS 232C

22. d. none of the above

23. d. all of the above

24. Large Scale Integration. Very complex digital circuits. Has more than 100 gates in one package. Typically will have many thousand gates on package.

25. a. contact sensors (microswitches)
b. Strain wire gauges.
c. non contact switches (photocells & LEDs)
d. vision sensors (CCD, Template)
e. proximity sensors (electromagnetic or limit)
f. hall effect sensors
g. thermocouples (heat)

EVALUATION AND TESTING

1. Completing the unit test with at least 70 percent accuracy.

2. Demonstrate the ability to identify the various applications to interface circuits.

3. Demonstrate the resourcefulness to distinguish the feasibility of interfacing robots to microcomputers.

4. Indication of the student resourcefulness to identify the types of sensors and their unique applications in robotics.

5. The student should be competent in the analysis of the multitude of robot safety features.

6. Active class and laboratory participation.

EQUIPMENT AND SUPPLIES

1. Educational robot. Suggest: Rhino robot XR3 or Microbot Teachmover

2. Textbook and supplementary materials for students and teacher.

BULLETIN BOARD IDEAS

1. Obtain and affix posters of safety factors of robotics from industrial manufacturers.

2. Obtain and affix posters showing interface circuits and applications.

3. Obtain and affix posters of a multitude of robot sensors.

SUPPLEMENTARY MATERIALS

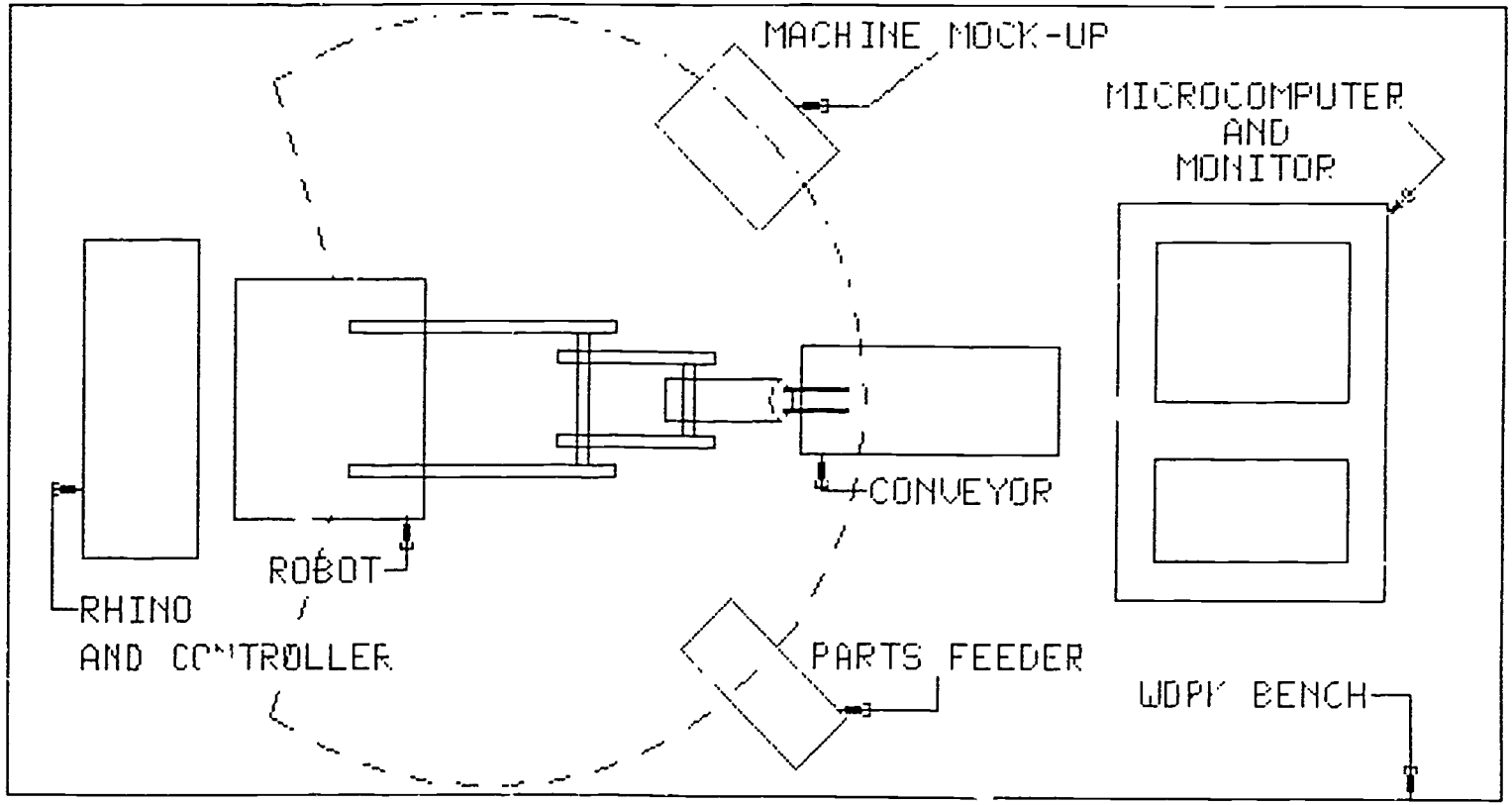
1. Borrow/purchase films from robot manufacturers.

2. Borrow/purchase periodicals from RIA or SME.

3. Make transparencies from the above periodicals.

BASIC ROBOT TRAINING STATION

TYPE A



EQUIPMENT REQUIREMENT

1	XR-2 RHINO ROBOT	4	LAB STOOLS
1	MICROCOMPUTER	1	STORAGE CABINET
1	CONVEYOR	1	MACHINE MOCK-UP - FABRICATED LOCALLY
1	WORK BENCH	1	PARTS FEEDER - FABRICATED LOCALLY

UNIT X

APPLICATIONS OF ROBOTS

INTRODUCTION

The primary purpose of this unit will be to analyze the applications of robotics in industrial manufacturing situations. We will begin with a discussion of the techniques used to determine the feasibility analysis for a robot implementation. Subsequently, we will discuss end effectors. At this juncture, it will be appropriate to study applications of robots in assembly, material handling and in quality control. It would be of great value for the students, if at all possible to visit an industrial automation site. This type of "field trip" will undoubtedly enhance any classroom learning.

COMPETENCIES

1. To analyze a manufacturing facility for a robotics application.
2. To calculate the Return on Investment (ROI) of industrial robot implementation.
3. To define payback analysis for a robot application.
4. To analyze the applications of end effectors on a given robot application.
5. To define the desired features of end effectors.
6. To examine applications of robots used in assembly, material handling, and quality control/quality assurance.

GENERAL PERFORMANCE OBJECTIVES/GOALS

1. The student should be confident in the analysis of a plant search for a robotics application.
2. The student should be able to define and use the economic theories used to calculate the Return on Investment (ROI) of robot implementation. The students should also be able to understand and define economic impact for a robot application.
3. The student should be able to analyze the applications of end effectors. Furthermore, the student should be able to define the desired features of end effectors.
4. To examine applications of robots in assembly, material handling and quality control/quality assurance.

SPECIFIC PERFORMANCE OBJECTIVES AND MASTERY CRITERIA

1.1 In a written test, the student should be able to analyze a hypothetical plant, for possible application of robots.

1.2 In a written test the student should be competent in defining: In retrofitting application, the robotics application considerations, including the economic analysis.

2.1 In a written test, the student should be able to define the characteristics of end effectors.

2.2 In a laboratory exercise, the student should be able to recognize the available end effectors, and define their applications.

2.3 In a written test the student should be cognizant in the applications of robots in a multitude of industrial processors.

METHODOLOGY

The methodology used in this unit will make the student familiar with the applications of industrial robots. The student should also be able to practice on the laboratory robot to arrive at logical definitions of end effectors. Further experimentation and visitation at a power/auto laboratory will assist the student in understanding the multitude of applications of robot systems.

SUGGESTED APPROACH

The extensive use of audiovisuals is highly recommended. Sample transparency sheets are attached in the appendices. Furthermore, visiting an automation or continuous manufacturing plant will assist in the cogitation of the subject matter. Student learning will be increased by the extensive demonstration and experimentation with the laboratory robot.

UNIT X OUTLINE

APPLICATIONS OF ROBOTS

I. Feasibility
   a. Plant search for possible robot application
   b. Economic analysis of robot implementation
   c. Productivity prediction using robots
   d. Payback analysis and return on investment study

II. End Effectors and End Of Arm Tooling (EOAT) Analysis
   a. Payload considerations
   b. Inertia analysis
   c. Center of gravity specifications
   d. Sensing techniques
   e. Mechanical operation
   f. Maintenance considerations

III. Assembly Applications

IV. Material Handling

V. Robotics In Quality Assurance and Quality Control

SPECIFIC PERFORMANCE OBJECTIVES

1.1 On a written test, the student should be able to analyze a hypothetical manufacturing plant, for possible application of robots.

Subject Matter Content	Learning Activities
Manufacturing plant search for robot applications	1. The examination of techniques used in a manufacturing plant; surveying for robot applications. 2. The review of the human factors (commitment) of applying robotics. 3. Choice of the robot for implementation. 4. Identify benefits/ drawbacks using robotics. 5. Modeling of proposed automation layout.

1.2 On a written test the student should be competent in defining: In retrofitting application, the robotics application considerations, and the Return On Investment (ROI).

Subject Matter Content	Learning Activities
Return on Investment	1. Examine the accounting method of ROI. 2. Examine the payback method of ROI. 3. Define the discounted cash flow method of ROI. 4. Calculate the life cycle of a robot.

2.1 In a written test, the student should be able to define the characteristics of end effectors.

Subject Matter Content	Learning Activities
Robot grippers and tooling	1. Review the robot's end of arm tooling. 2. Define other types of tooling for various applications.

2.2 In a ›ratory exercise, the student should be able to recog the available end effectors, and define their applications.

Subject Matter Content	Learning Activities
End effectors	1. Demonstrate and experiment with the laboratory robots end effectors.

2.3 In a written test the student should be cognizant in the applications of robots in a multitude of industrial processors.

Subject Matter Content	Learning Activities
Robot applications	1. Define the various types of robot application including material handling, die casting, welding, inspection, assembly, spray painting, quality control, and quality assurance.

ACTIVITY SHEET

1. Experiment with moving the various manipulators interfaced to the robot.

2. Experiment with the laboratory robot, simulating an industrial application of the robot.

ACTIVITY SHEET KEY

1. The student should be cognizant of the robot manipulators via moving the experimenting robot around.

2. The student should be able to define an industrial application of the simulated application of the laboratory robot.

UNIT X TEST

1. During a plant survey for a robotics application, two items of paramount interest are:
   a. robot abilities and robot cost
   b. robot cost and current activities which are productive
   c. robot abilities and current activities which are productive
   d. none of the above.

2. The most fundamental decision of whether or not to acquire robots is ultimately based on economics.
   a. true b. false

3. The gripper type of end effector is used for:
   a. part lifting b. part transfer
   c. all of the above d. none of the above.

4. The discounted cash flow method for the Return on Investment of a robotics application includes accounting for the value of money over a period of time, because of the existence of alternative investments.
   a. true b. false

5. Significant characteristics of magnetic grippers include: temperature limiting factors; gripper always parallel to the part; and the need for the part to be ferrous.
   a. true b. false

6. To complete the documentation of the proposed robotics system, it would be prudent to quantify payloads and operation times.
   a. true b. false

7. Two major classifications of end effectors are:
   a. vacuum and electric
   b. mechanical and electrical
   c. gripper and end of arm tooling
   d. vertical and horizontal

8. The accounting method of Return on Investment for a robotics application includes accounting for:
   a. the effect on the company income and expense accounts
   b. the cost of capital recovery
   c. both of the above
   d. none of the above

9. During a plant survey for a robotics application, the data must be accumulated for the technical, economic, and human factors.
   a. true b. false

10. Human factors which enter the considerations of a plant survey for a robotic application include:
    a. operators who must be retrained or eliminated
    b. hostile attitude of workers
    c. management ignorance of the abilities of robots
    d. all of the above

11. At the initial stages of identifying a potential robot application, it is unnecessary and would be detrimental to consider the potential drawbacks of robotics application.
    a. true b. false

12. In modeling a proposed layout for a robot/automation application, considerable assistance could be to form:
    a. a computer assisted manufacturing (CAM) package
    b. a computer assisted design (CAD) package
    c. a designing with an industrial robot's
    d. none of the above.

13. The End-of-arm tooling type of end effector is used for:
    a. making changes in a part
    b. operating on a part
    c. all of the above
    d. none of the above

14. Human factors which enter the considerations of a plant survey for a robotic application include:
    a. process layout considerations
    b. product characteristics
    c. all of the above
    d. none of the above

15. The payback method of ROI for a robotics application includes accounting for:
    a. the number of periods required for cumulative benefits to equal the cumulative costs
    b. the salvage value of the robot
    c. both of the above
    d. none of the above

16. The work being done by the robot includes: welding, gluing and spray painting. At the end of the manipulator there is:
    a. a gripper
    b. end-of-arm tool(s)
    c. are actuators
    d. none of the above

17. The actual work of the robot is done by the manipulator is accomplished by the _____.

18. In a robotics application, it is important to identify the real objectives of the application, because this supercedes the actual capability of the robot for that application.
a. true b. false

19. The repeatability process of modeling for robot application includes using wire modeling. Some software packages are pre-programmed to represent various commercially available robots.
a. true b. false

20. The gripper of the end of arm tooling has two parts. These are the fingers that grip a part and the actuating circuitry.
a. true b. false

UNIT X TEST KEY

1. C.
2. A.
3. C.
4. A.
5. A.
6. A.
7. C.
8. C.
9. A.
10. D.
11. B.
12. A.
13. C.
14. D.
15. A.
16. B.
17. END EFFECTOR.
18. B.
19. A.
20. A.

EVALUATION AND TESTING

1. Completing the unit test with at least 70 percent accuracy.

2. Demonstrate the ability to identify the various applications of robots.

3. Demonstrate the resourcefulness to distinguish the feasibility to apply robots to industry.

4. Indication of the student resourcefulness to identify the types of end effectors and their unique applications.

5. The student should be competent in the analysis of the multitude of robot applications.

6. Active class and laboratory participation.

EQUIPMENT AND SUPPLIES

1. Educational robot. Suggest: Rhino robot XR3 or Microbot Teachmover

2. Textbook and supplementary materials for students and teacher.

BULLETIN BOARD IDEAS

1. Obtain and affix posters of feasibility studies of robotics.

2. Obtain and affix posters end effectors and their applications.

3. Obtain and affix posters of a multitude of applied robots.

SUPPLEMENTARY MATERIALS

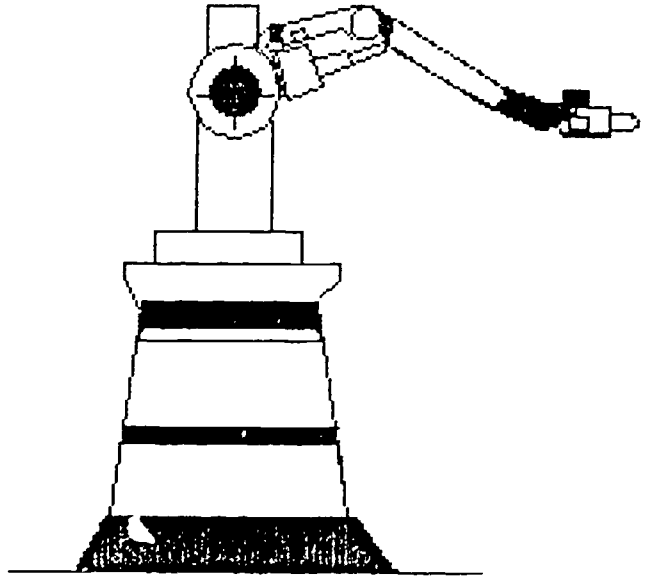
1. Borrow/purchase films from robot manufacturers
2. Borrow/purchase periodicals from RIA or SME
3. Make transparencies from the above periodicals

TYPE OF ROBOT	TYPE OF JOB								
	PART HANDLING	MATERIAL HANDLING	TOOL HANDLING	SPECIAL DEVICE HANDLING	PALLETIZING	INSPECTION	ASSEMBLY	PACKAGING	MOVING LINE OPERATION
NON SERVO POINT TO POINT	✓ LIMITED PAYLOAD CAPACITY	✓ LIMITED PAYLOAD CAPACITY				✓ LIMITED TO SIMPLE PARTS HANDLING TASKS	✓ LIMITED TO SIMPLE PARTS HANDLING TASKS	✓ LIMITED TO SIMPLE PARTS HANDLING TASKS	
SERVO POINT TO POINT	✓	✓ PAYLOAD CAPACITY UP TO 2000 LBS	✓ GENERAL PURPOSE	✓	✓	✓ PARTS OR INSPECTION DEVICE HANDLING	✓ PARTS OR ASSEMBLY TOOL HANDLING	✓	✓ LINE TRACKING
SERVO CONTINUOUS PATH				✓ SPECIAL PURPOSE DEVICES					✓

ROBOT APPLICATIONS.

ADVANTAGES OF ROBOTS

* PRODUCT QUALITY
* PRODUCT CONSISTENCY
* LOWER REJECTION RATE
* SHORTER PRODUCTION RUNS
* QUICK PROJECT CHANGES
* MORE COMPETITIVE
* FIXED COST ITEM



UNIT XI

IMPACT OF ROBOTICS ON SOCIETY

INTRODUCTION

We are being rapidly engrossed in a new industrial revolution era, the era of robotics and automation. This era, like the other milestones in the illustrious history of industrial progress has its major impact on society. Of these impacts the advantage of "doing things with robots" has become a reality.

With the advantage of robotics we also have the disadvantages of implementing robots. One of these is worker displacement. There is much to be desired in the process of improving efficiency. However, the means of improving efficiency results in unemployment for a sector of our populace. As fellow human beings, we must diligently seek the means of reliving the suffering of those unemployed.

It is also imperative that future generations will be qualified to adapt to the emerging technologies of robotics.

It is also the purpose of this unit to analyze the advantages of using robots. Furthermore, this unit will be to consider the unemployment due to robotics implementation, and the attitudes of management to this dilemma.

COMPETENCIES

1. List the attitudes society places on robotics implementation within the workplace.
2. Discuss the levels of education and training required for people to effectively manage industrial robots.
3. Determine the occupations becoming available in robotics considering the students own career management.

GENERAL PERFORMANCE OBJECTIVES/GOALS

1. The students need to be able to evaluate and gauge the general attitudes of society to robotics and the implementation of automation systems. Furthermore, the student should be aware of the theory X and theory Y of robotics.

2. The students should be able to consider the human interface to a robotic application. Thus the ability to consider the value of a educated workforce, and having an occupation which would be satisfying.
3. The significance of continuing education, and the

3. The significance of continuing education, and the techniques of educating the workforce will also be objectives in this unit.

SPECIFIC PERFORMANCE OBJECTIVES AND MASTERY CRITERIA

1.1 On a written evaluation, the student will be able to define the current society concept of robotics.
1.2 The student should be able to define the public's opinion on the outcome of the implementation of robotics.
1.3 The student should be cognizant of the theory X and theory Y of implementation of robotics.
2.1 On a written evaluation the student should be able to evaluate the techniques of successful interfacing of humans to robotics applications.
2.2 On a classroom exercise, the student should be able to define the value of continuing their education.
2.3 On a written test, the student should be able to define the purpose and benefits of the populace in dignified occupations.
3.1 On a classroom exercise, the student should be able to discuss the importance of one's career management.

METHODOLOGY

The methodology used in this unit will be to make the student familiar with the implications of the technology and the applications of robotics. The student will also be able to participate in the classroom discussion of the ethics of the application of robots. Desired results would be to arrive at logical definitions of the ethical considerations of the application of automation. Further learning would be derived via a visitation by an employment agent, who specializes in the placement of automation technologists.

SUGGESTED APPROACH

The extensive use of classroom "round-table" discussions are highly recommended. Furthermore, arranging for a classroom talk by an employment agent, who specializes in the placement of automation technologists, will assist in the cogitation of the subject matter. It would be prudent to invite an official from the local labor union to also address the subjects of this unit.

IMPACT OF ROBOTICS ON SOCIETY

I. Attitudes of Society
   a. Advantages of robots doing the undesired tasks
   b. Unemployment due to robot implementation
   c. Theory X and theory Y of robotics

II. Human interface
   a. Educated work-force
   b. Dignified occupations

III. Career management
   a. Education of employees
   b. Continuing education on emerging technologies

SPECIFIC PERFORMANCE OBJECTIVES

1.1 On a written evaluation, the student should be able to define the current society concept of robotics.

Subject Matter Content	Learning Activities
Societal attitudes toward robotics	1. Discuss: is automation the biggest influence on manufacturing? 2. Examine if robotics and automation is the cure for all our productivity problems.

1.2 The student should be able to define the public's opinion on the resultant of the implementation of robotics.

Subject Matter Content	Learning Activities
Public opinion: effects of robot implementation	1. Discuss: is automation a villain? 2. Examine the terminology of worker displacement, job elimination and unemployment.

1.3 The student should be cognizant of the theory X and theory Y of implementation of robotics.

Subject Matter Content	Learning Activities
Theory X and Theory Y	1. Discuss Theory X. 2. Discuss Theory Y.

2.1 On a written evaluation the student should be able to evaluate the techniques of successful interfacing of humans to robotics applications.

Subject Matter Content	Learning Activities
Interfacing humans to robotics	1. Examine the significance of the integration of workers to the robot implementation stage. 2. Discuss the potential "roadblocks" to automation via worker resentment, and techniques of avoidance of the latent resentment.

2.2 On a classroom exercise, the student should be able to define the value of continuing their education.

Subject Matter Content	Learning Activities
Continuing education	1. Examine the purpose of continuing education. 2. Define the advantages/ necessity of continuing education.

2.3. On a written test, the student should be able to define the purpose and benefits of the populace in dignified occupations.

Subject Matter Content	Learning Activities
Populace in dignified occupations	1. Examine the "dignified" occupations. 2. Define social aspects of occupational satisfying.

3.1 On a classroom exercise, the student should be able to discuss the importance of one's career management.

Subject Matter Content	Learning Activities
Career management	1. Define the career opportunities in robotics. 2. Explain the techniques to avoid becoming technically obsolescent.

ACTIVITY SHEET

1. Have students experiment with moving the various manipulators interfaced with the robot.

2. Students should experiment with the laboratory robot, simulating an industrial application of the robot.

ACTIVITY SHEET KEY

1. The student should be cognizant of the robot manipulators via moving the experimenting with the same.

2. The student should be able to define an industrial application of the simulated application of the laboratory robot.

UNIT XI TEST

1. The principle purpose of robots in manufacturing is to:
   a. break the Unions.
   b. destroy the blue collar workers.
   c. mystic of robots.
   d. make the process more efficient.

2. General populace views robots and automation as a:
   a. threat to worker security.
   b. redeemable feature of management.
   c. fact good for worker security.
   d. none of the above.

3. Worker displacement will result in:
   a. swelling of the ranks of the unemployed.
   b. manufacturing automation.
   c. create new jobs.
   d. none of the above.

4. Theory Y of automation states that:
   a. automation causes unemployment.
   b. automation prevents unemployment.
   c. this theory does not address unemployment.
   d. none of the above.

5. One fact that can be used to prove that robots cause unemployment is that: Japan has more industrial robots than the United States. The United States has a higher unemployment rate than Japan.
   a. The above is a valid argument.
   b. The above is not a valid argument.

6. Analysis of worker displacement must take into account the age group of the workers. Typically the group with the greatest potential for displacement is the 25 to 35 year old workers.
   a. true b. false

7. Examples of significant methods of avoiding social upheaval (due to the implementation of robots) would be to observe a management policy of humaneness, transitional counseling and relocation/retraining assistance.
   a. true b. false

8. The public image of automation is conventionally:
   a. good for everybody.
   b. good for small businesses.
   c. good for the Japanese.
   d. a villain underlying unemployment.

9. Analysis of worker displacement must take into account the age group of the workers. Typically the group with the least potential for displacement is the 45-55-year-old workers.
   a. true b. false

10. In the interfacing of humans to robots, it is known that robot operators will be primarily "watching" rather than "doing" activities. This is an interface problem, because operators typically prefer "doing" to "watching".
   a. true b. false

11. The principle argument for theory Y is that in the arena for intense world competition, it is necessary to install robots.
   a. true b. false

12. In an analysis of worker displacement it was concluded that typically the group with the least potential for displacement is the 45 to 55 year old workers. This is because:
   a. they are necessary to supervise the robot tasks.
   b. they are necessary to "lead the youth" of the plant.
   c. all of the above.
   d. none of the above. The senior/older workers would be the first to be displaced.

13. Projected growths of the occupations in metal working and manufacturing industries presuppose:
   a. the availability of cheap energy.
   b. the availability of fast computers.
   c. the availability of a skilled workforce.
   d. the limiting of the growth of the Japanese economy.

14. One of the major problems with the implementation of robotics is the human interface. Current research indicates that automation causes worker alienation, thus changes the formal and informal interaction patterns of workers and their co-workers.
   a. true b. false

15. Theory X of automation states that:
   a. automation causes unemployment.
   b. automation prevents unemployment.
   c. this theory does not address unemployment.
   d. none of the above.

16. Due to the implementation of robots, it can be assumed that approximately 25 percent of the industrial work force will be removed from the work force in the 1990s.
   a. true b. false

17. In an analysis of worker displacement it was concluded that typically the group with the least potential for displacement is the 25 to 35 year old workers. This is because:
    a. they are necessary to maintain the robot.
    b. they are necessary for other functions of the plant.
    c. all of the above.
    d. none of the above. The younger workers would be the first to be displaced.

18. For the people planning to enter the "robot system workforce" it is most recommended to enroll in an easily accessible robot training program supplied by the robot vendor.
    a. true b. false

19. Typically, when one robot is installed the number of displaced workers is:
    a. one person.
    b. less than the capacity of one person.
    c. more than the productivity of one person.
    d. all of the above, but depends on the function.

20. Proponents of the theory Y of robot implementation argue that robots are job makers, because it requires humans to build and maintain robots. Thus, even though the skills may change, the net employment will increase with the implementation of robots.
    a. true b. false

UNIT XI TEST KEY

1. D
2. A
3. C
4. B
5. B
6. B
7. A
8. D
9. A
10. A
11. B
12. C
13. C
14. A
15. A
16. A
17. D
18. B
19. C
20. A

EVALUATION AND TESTING

1. Completing the unit test with at least 70 percent accuracy.
2. Demonstrate the ability to identify the various implications due to the application of robots.
3. Demonstrate the resourcefulness to distinguish the positive versus negative factors of automation.
4. Indication of the student resourcefulness to identify the theories of automation, and their social implications.
5. The student should be competent in the analysis of the purpose of training and continuing education in robotics.
6. Active class discussions.

EQUIPMENT AND SUPPLIES

1. Educational robot. Suggest: Rhino robot XR3 or Microbot Teachmover
2. Textbook and supplementary materials for students and teacher

BULLETIN BOARD IDEAS

1. Obtain and affix posters of statistics on unemployment.
2. Obtain and affix posters of the local institutes teaching robotics.

SUPPLEMENTARY MATERIALS

1. Borrow/purchase films from robot manufacturers.
2. Borrow/purchase periodicals from RIA or SME.
3. Make transparencies from the above periodicals.

UNIT XII

TEACHING MICROPROCESSORS AND ROBOTICS THROUGH AIASA COMPETITIVE EVENTS

INTRODUCTION

The American Industrial Arts Student Association (AIASA) sponsors competitive events that prepare students to present speeches, to write research papers, and to display a technological process. These events have been authored by experts and tested through use. They have made significant contributions to the intellectual and professional development of industrial education students, and they have the highest recommendations.

Students need to voice an opinion, to write to the editor or legislator, to demonstrate for an idea or belief. They need to become active in decisions about their education and responsible for the quality of that education. Through AIASA competitive events, students can have an impact on decisions made on campus, in board rooms, and in the halls of the legislature by:

1. learning to speak at public meetings and thus gaining confidence and developing leadership;
2. producing research papers that merit attention from corporate technocrats and literary aristocrats; and
3. creating displays of technological processes that require a team of students to have a thorough understanding of the concepts and skills required to present the process in a concise, easily understood display.

COMPETENCIES

1. Know and understand the purposes of the AIASA competitions.
2. Know and be able to explain the AIASA rules for the prepared speech competition.
3. Know and be able to explain the AIASA rules for the research paper competition.
4. Know and be able to explain the AIASA rules for the technology process display competition.
5. Present a prepared speech on any topic relevant to microprocessors or robotics technology with the approval of the instructor and according to AIASA regulations.
6. Write a research paper on an approved microprocessor or robotics topic according to AIASA rules.

7. Participate on a team that fabricates a display of a microprocessor or robotics technological process consistent with AIASA rules.

GENERAL PERFORMANCE OBJECTIVES/GOALS

1. Know the meaning of the acronym AIASA and know the association's history, goals, activities and impact on industrial education.
2. Know the purpose of the prepared public speaking competitive event.
3. Know the purpose of the research paper competition.
4. Know the purpose of the technology process display contest.
5. Explain the rules of the three AIASA competitive events cited above.
6. Demonstrate ability to speak effectively before the class using only minimal notes.
7. Demonstrate the ability to write effective research papers.
8. Demonstrate ability to work cooperatively and effectively with others in selecting, researching, constructing, and displaying technology process displays.

SPECIFIC PERFORMANCE OBJECTIVES AND MASTERY CRITERIA

1.1 On a written test, students will demonstrate knowledge of the meaning of the acronym AIASA and know the association's history, goals, activities, and impact on industrial education.

2.1 On a written test, students will demonstrate knowledge of the stated purposes of three competitive events, the Prepared Speech, Research Paper, and the Technology Process Display.

3.1 On a written test, students will demonstrate knowledge of the AIASA rules for the Prepared Speech competition and be able to describe situations typical of the high school environment in which the skills learned through this competitive event could serve to persuade others more effectively.

3.2 In a mock exercise designed to provide experience and expertise, students will demonstrate knowledge of the rules and acquired skills related to the Prepared Speech competition by acting as speakers, judges, timekeepers, contest coordinators, and audience.

4.1 On a written test, students will demonstrate knowledge of the AIASA rules for the Research Paper competition and be able to describe situations typical of the high school environment in which the skills learned through this competitive event could serve to persuade others more effectively.

4.2 In a practice exercise designed to develop experience and expertise, students will demonstrate knowledge of the rules and acquired skills related to the Research Paper competition by writing such a paper, by acting as presenters, judges, timekeepers, contest coordinators, and audience.

5.1 On a written test, students will demonstrate knowledge of the AIASA rules for the Technology Process Display and be able to describe situations typical of the high school environment in which the skills learned through this competitive event could serve to persuade others more effectively.

5.2 In a laboratory exercise designed to provide experience and expertise, a minimum of two teams will be chosen to select, research, construct, and display a technology process, while other students act as contest coordinator, judges and helpers.

METHODOLOGY

The American Industrial Arts Association has prepared lesson plans appropriate to each of the competitive events outlined in this unit. With slight modifications as may be desired, they can serve as an excellent instructional resource, along with other supplementary materials recommended throughout this unit.

SUGGESTED INTEREST APPROACHES

1. Mock or legitimate competitions may take place among students of the same or different classes, instructors, schools, etc.
2. Coordinate research assignments with English/Science teachers so that students may learn more about research writing techniques and delivery as well as the research topic, and may, therefore, earn two grades, one for technical content, and another for creative writing.
3. Get local businesses to suggest technical processes used within their facilities which students may tour, study, and adapt to creative displays that can eventually be donated to the business partner.
4. Challenge the Ecology, Science, VICA, FHA, DECA, FBLA, FFA and other clubs to compete under AIASA regulations.
5. As students gain experience and confidence in public speaking, invite them to speak at civic and social club meetings.

UNIT XII OUTLINE

TEACHING MICROPROCESSORS AND ROBOTICS THROUGH

AIASA COMPETITIVE EVENTS

A. AIASA Background Information

B. AIASA Competitive Events

C. Prepared Speech Competition
   1. rules
   2. lesson plan in supplementary materials

D. Research Paper Competition
   1. rules
   2. lesson plan in supplementary materials

E. Technology Process Display Competition
   1. rules
   2. lesson plan in supplementary materials

SPECIFIC PERFORMANCE OBJECTIVES

1.1 On a written test, students will demonstrate knowledge of the meaning of the acronym AIASA and know the association's history, goals, activities, and impact on industrial education.

Subject Matter Content	Learning Activities
AIASA Background	1. Review the AIASA publication, "All About AIASA." 2. Examining the publication, "The Benefits of AIASA/LIASA," for a unit test.

2.1 On a written test, students will demonstrate knowledge of the state purposes of three competitive events, the Prepared Speech, Research Paper, and the Technology Process Display.

Subject Matter Content	Learning Activities
General Rules and Purpose of Events	1. Studying "General Rules" for AIASA competitive events.

2. Reviewing the specific rules for the Prepared Speech, Research Paper, and Technology Process Display.
3. Listing the purposes for each event for a unit test.

3.1 On a written test, students will demonstrate knowledge of the AIASA rules for the Prepared Speech competition and be able to describe situations typical of the high school environment in which the skills learned through this competitive event could serve to persuade others more effectively.

Subject Matter Content	Learning Activities
Prepared Speech Rules and Objectives	1. Studying the rules for the Prepared Speech competition to understand the proposed objectives. 2. Determining situations typical of the high school environment in which the desired skills could effectively persuade others, such as in class officer campaign election, student council meetings, student club meetings, etc.

3.2 In a mock exercise designed to provide experience and expertise, students will demonstrate knowledge of the rules and acquired skills related to the Prepared Speech competition by acting as speakers, judges, timekeepers, contest coordinator, and audience.

Subject Matter Content	Learning Activities
Prepared Speech Mock Competition	1. Utilizing the AIASA Lesson Plan found in supplementary materials to examine the rules and goals of this event thoroughly for a unit test. 2. Conducting mock contests to develop and practice needed skills.

4.1 On a written test, students will demonstrate knowledge of the AIASA rules for the Research Paper competition and be able to describe situations typical of the high school environment in which the skills learned through this competitive event could serve to persuade others more effectively.

Subject Matter Content	Learning Activities
Research Paper Rules and Objectives	1. Studying the rules for the Research Paper Competition to understand the proposed objectives. 2. Determining situations typical of the high school environment in which skills acquired through researching and writing reports could effectively persuade others through letters to the school paper, the principal, the coach, a local school board member, or even to a special friend.

4.2 In a practice exercise designed to develop experience and expertise, students will demonstrate knowledge of the rules and acquired skills related to the Research Paper competition by acting as presenters, judges, timekeepers, contest coordinators, and audience.

Subject Matter Content	Learning Activities
Research Paper Mock Competition	1. Utilizing the AIASA Lesson Plan found in the supplementary materials to examine the rules and goals of this event thoroughly for a unit test. 2. Conducting mock contests to develop and practice needed skills.

5.1 On a written test, students will demonstrate knowledge of the AIASA rules for the Technology Process Display and be able to describe situations typical of the high school environment in which the skills learned through this competitive event could serve to persuade others more effectively.

Subject Matter Content	Learning Activities
Technology Process Display Rules and Objectives	1. Studying the rules for the Technology Process Display competition to understand the proposed objectives. 2. Determining situations typical of the high school environment in which the skills learned by producing a technological display could be used effectively to persuade others. Examples: campaigns against drug or alcohol abuse, property tax elections, a home-coming dance display, senior memorabilia display, etc.

5.2 In a laboratory exercise designed to provide experience and expertise, a minimum of two teams will be chosen to select, research, construct, and display a technology process, while other students act as contest coordinator, judges, and helpers.

Subject Matter Content	Learning Activities
Technology Process Display Mock Competition	1. Utilizing the AIASA Lesson Plan found in the supplementary materials to examine the rules and goals of this event thoroughly for a unit test. 2. Conducting mock contests to develop and practice needed skills.

EVALUATION AND TESTING

Students will be evaluated by the following guidelines:

1. Complete the unit test with at least 70% accuracy;
2. Demonstrate to the judges those positive traits listed on the scoring sheet for each competitive event; and
3. Placement after each competition.

Students can accept the responsibility to act as judges, thus demonstrating their understanding of the positive traits to be evaluated and fostering a sense of fair play among peers.

Judges may be selected from among local school staff, neighboring schools, local business partners or local politicians. The advantages of a viable liaison between the school and business community are numerous and far-reaching to the Industrial Arts/Technology Education Program. Community leaders are excellent role models and professional contacts, and they are often interested in making a positive and meaningful contribution to the quality of education.

EQUIPMENT AND SUPPLIES

Recommendations for equipment and supplies must differ according to the infinite creative variations that technology process displays and designs require. Schools may choose to involve business partners or student organizations in determining which microprocessor or robotics processes to display and what equipment and supplies should be obtained.

Detailed equipment and supplies are listed within the AIASA lesson plans as they pertain to specific projects.

BULLETIN BOARD IDEAS

1. Creative displays showing photographs of microprocessor or robotic processes that students may select.
2. Photographs showing the steps taken to bring a successful microprocessor or robotics technology process display to completion.
3. Exhibits including the necessary correspondence between teachers and competition judges and including comments by judges about the quality of the work submitted by students.

4. Schedules posted of debating activities of university debate clubs or local debate societies. Encourage students to attend and to score the speakers using modified AIASA rules.

SUPPLEMENTARY MATERIALS

1. See equipment and supplies listed in AIASA Lesson Plans.

SUPPLEMENTARY MATERIALS

PREPARING FOR STATE LEADERSHIP CONFERENCE CONTESTS

TITLE: RESEARCH PAPER CONTEST

OBJECTIVE:

Having received a lecture on the purpose and specific regulations regarding the Research Paper Entry Contest, the student will be able to develop a research paper on a subject of his/her choice that relates to Industrial Arts. The paper should include evidence of organization, support evidence, correct mechanics and footnotes as well as interest and originality.

RESOURCES:

Chalkboard
Rating Sheet Transparencies
Overhead Projector
Suggestions from former contest winners
Suggestions from English Teachers
AIASA Competitive Events Guidelines

INTRODUCTION:

The purpose of the Research Paper Contest is to familiarize and inform students with effective and efficient methods to use research materials in a studious inquiry of a subject related to the field of industrial arts. These papers will be shared with the other AIASA members after the conference.

CONTENT:

1. Review of the objective of the lesson and the Research Paper Contest.
2. Stress key points in introduction.
3. Show transparency TM 8-1 and TM 8-2 entitled "Specific Regulations".
4. Be sure to stress item F which is the basic outline. Write the following on the chalkboard and discuss each of the following items:
    a. Title Page
    b. Table of Contents
    c. Chapter I Introduction
    d. Chapter II Review of Literature, Body of Report
    e. Chapter III Conclusion
    f. Footnotes, if applicable
    g. Bibliography
    h. Appendix

5. Be sure everyone understands the meaning of all the terms.
6. Show transparency TM 8-3.
7. Assign a homework assignment using the suggested outline.
8. Review content of transparency TM 8-4.
9. Show transparency TM 8-5 and discuss each of the following:
    a. Organization
    b. Evidence
    c. Mechanics
    d. Interest and Originality
10. If you have research papers from former years, have the author or someone else read them or discuss them with the class.
11. Conduct a discussion on the merits of each of the research papers.
12. Seek the advice or participation of the English Teachers in your school.
13. Request that other teachers or interested parents serve as judges.
14. Assign other assignments that can be accomplished using the research paper format or outline.
15. Give the evaluation.
16. Grade evaluation and conduct a discussion on what the students have learned about themselves and their writing ability.

APPLICATION:

Each student will take notes and be prepared to discuss how a research paper can be prepared.

a. Have students discuss each of the eight (8) parts in the basic outline of the report.
b. Answer any questions that may be asked.

SUMMARY:

a. Review lesson objective.
b. Review important points of introduction.
c. Point out key points covered in the specific regulations.
d. Review the basic outline of the project.

EVALUATION:

1. Is the research paper an individual or group project?
2. How many research papers may a chapter enter in the contest?
3. What is the maximum number of pages you are to limit your research paper, excluding the bibliography?

4. Can the research paper be hand-lettered?
5. What is the size of paper to be used?
6. Arrange the following in their correct order as they would appear on the basic outline:
    a. Introduction
    b. End notes
    c. Table of Contents
    d. Conclusion
    e. Title Page
    f. Review of literature, body of the report
    g. Appendix
    h. Bibliography

ANSWERS TO EVALUATION:

1. Individual--it is not a group project.
2. Two--each chapter may enter two (2) research papers.
3. Ten (10) pages is the limit but this does not include the bibliography.
4. NO. The research paper is to be typewritten and double spaced.
5. 8 1/2 " x 11" plain white paper (one side only).
6. Correct basic outline:
    a. Title page
    b. Table of Contents
    c. Introduction
    d. Review of Literature, Body of the Report
    e. Conclusion
    f. End notes
    g. Bibliography
    h. Appendix

RESEARCH PAPER CONTEST

SPECIFIC REGULATIONS

A. THE RESEARCH PAPER IS TO BE PREPARED AND COMPLETED PRIOR TO THE AIASA CONFERENCE.

B. THE RESEARCH PAPER IS AN INDIVIDUAL PROJECT. NO RECOGNITION WILL BE GIVEN TO A GROUP EFFORT. A CHAPTER MAY ENTER NOT MORE THAN TWO (2) RESEARCH PAPERS. LOCAL CHAPTER ELIMINATION CONTESTS ARE SUGGESTED.

C. THE INRODUCTION, REVIEW OF RELATED LITERATURE, AND CONCLUSION SHALL BE LIMITED TO TEN (10)PAGES.

D. CHARTS, TABLES, DRAWINGS, DIAGRAMS, AND SHORT REPRINTS OF REFERENCE MATERIAL ARE TO BE PLACED IN THE APPENDIX.

THESE PAGES WILL NOT COUNT AS PART OF THE TEN (10) PAGES OF THE RESEARCH PAPER.

E. A BIBLIOGRAPHY OF ALL REFERENCES USED IS TO BE INCLUDED IN THE RESEARCH PAPER.

THIS WILL NOT COUNT AS PART OF THE TEN (10) PAGES REFERRED TO IN "C" ABOVE.

RESEARCH PAPER CONTEST

F. THE BASIC OUTLINE SHALL INCLUDE:

TITLE PAGE
TABLE OF CONTENTS
CHAPTER I - INTRODUCTION
CHAPTER II - REVIEW OF LITERATURE, BODY OF THE REPORT
CHAPTER III - CONCLUSION
END NOTES, IF APPLICABLE
BIBLIOGRAPHY
APPENDIX

G. THE RESEARCH PAPER SHALL BE TYPEWRITTEN, DOUBLE SPACED, ON ONE SIDE ONLY OF GOOD QUALITY 8½" X 11" PLAIN WHITE PAPER.

H. THE TOPIC OF THE RESEARCH PAPER MAY BE RELATED TO ANY PHASE OF INDUSTRIAL ARTS.

SAMPLES OF RESEARCH PAPER TOPICS

CHOOSE ONE OF THE ALTERNATIVES LISTED BELOW. THE PAPER SHOULD BE A MAXIMUM OF 10 PAGES, NOT INCLUDING BIBLIOGRAPHY. DUE ON _____ (DATE TO BE PROVIDED).

I. 4 TYPES OF ALLOYS, ALUMINUM, BRASS, ETC.
   - A. HISTORY
   - B. WHAT MINERALS MAKE UP EACH TYPE OF ALLOY?
   - C. USES
     1. ADVANTAGES
     2. DISADVANTAGES
     3. MARKETS
     4. AVAILABILITY
     5. COST

II. WELDING
   - A. HISTORY
   - B. TYPES OF WELDING, I.E., ARC, GAS, ETC.
   - C. WHERE AND WHEN USED FOR EACH TYPE
   - D. ADVANTAGES AND DISADVANTAGES OF EACH TYPE

III. METALS
   - A. HISTORY
   - B. STEEL - 5 TYPES, I.E., COLD ROLLED, HOT ROLLED,ETC.
   - C. WHERE AND WHEN USED AND WHY, I.E., STRENGTH, ECONOMY
   - D. SHAPES - ANGLES, SQUARE, ETC.
   - E. COST AND AVAILABILITY FOR EACH TYPE

I. The Title Page (which must be removable for judging the Research Paper) is to be included at the beginning of the paper, using the following format: Note: The title of the Research Paper must also be listed at the top of the first page of the Research Paper.

TITLE OF PAPER

being

A Paper Entered In The

RESEARCH PAPER CONTEST

by

John Q. AIASA Member

Chapter Name_____ Level _____

School Name_____ Grade_____

School Address_____ Entry Number_____
(assigned by coordinator)

_____

Date _____ Approved_____
AIASA Local Advisor

1. The Title Page will not count as one of the ten (10) pages.

2. Contestants may not have entered this Research Paper at any previous National Conference.

J. The original and two copies of the Research Paper shall be mailed to the Contest Events Coordinator by the pre-set deadline date. NOTE: NO ENTRIES WILL BE ACCEPTED THAT ARE POST-MARKED BEYOND THE DEADLINE DATE. (It is advisable to keep an additional copy of the Research Paper.)

SCHOOL_____

STUDENT'S NAME_____

AIASA Research Paper Contest Rating Sheet

100 POSSIBLE POINTS	JUDGING CRITERIA	POINTS AWARDED
25	Organization: The point of the Research Paper should be clearly stated and logically, systematically presented.	
25	Evidence: The point of the Research Paper should be supported by specific evidence. Materials from research should fit the point of the paper.	
25	Mechanics: Spelling, sentence structure, and paragraphing should reflect standard usage. Research material must be end noted.	
25	Interest and Originality: The topic, approach, or pr sentation should reflect some original thinking by the author. The paper should hold the interest of the reader.	
		TOTAL CONTEST POINTS

Judge's Signature

Transparency Master TM 8-5

PREPARED SPEECH

OVERVIEW: AIASA contestants in Prepared Speech are required to deliver a memorized speech of three (3) to five (5) minutes in length on a topic related to industrial or technology fields.

I. CONTEST PURPOSE

The purpose of the Prepared Speech contest is to provide a mean for AIASA members to demonstrate their ability to communicate verbally to an audience.

II. ELIGIBILITY FOR ENTRY

Entries are limited to two (2) per chapter.

III. LEVELS OF COMPETITION

Level I and Level II as described in General Rules.

IV. TIME LIMITATIONS

Each speech shall not be less than three (3) minutes or more than five (5) minutes. The Contest Coordinator shall introduce the contestant by number only and the contestant may introduce his/her speech by title only. The timekeeper shall visually notify the speaker of the time remaining by using six separate cards. Each of the six cards shall have a number (4, 3, 2, 1, 1/2, 0) shown in descending order to the contestant by the timekeeper during the speech. Contestants will be penalized on each judge's score sheet one point per each ten-second interval for speaking over or under the allotted time. Time commences when the speaker begins talking.

V. SPECIFIC REGULATIONS

A. Each speech shall be the result of the contestant's own efforts, utilizing any reference materials which the contestant wishes to use.

B. Topic selection - Contestants may choose the subject for their speech; however, the subject must pertain to AIASA and/or relate to Industrial Arts/Technology Education.

AIASA 12/85

C. A bibliography MUST be submitted to the judges before presenting the speech. Ten (10) points shall be deducted for contestants who fail to submit a bibliography.

D. Contestants may use two 3x5 cards for notes. However, deductions in scoring may be made for this practice if it detracts from the effectiveness of the presentation.

E. Contestants will not be allowed to hear other contestants' presentations.

VI. PROCEDURE

A. Registration - Contest participants must register for the event in accordance with procedures established for each conference.

B. Participation Sequence - Students will gather at one location as identified at registration to draw/sign-up for speaking times.

C. Introduction - The Contest Coordinator shall introduce each contestant by number and in order of the drawing.

D. Audience - Observers other than contestants will be allowed to sit in the audience of the performance room. No talking or gesturing will be permitted. Observers will NOT be allowed to enter or leave during a speech. APPLAUSE SHALL BE WITHHELD UNTIL ALL CONTESTANTS HAVE SPOKEN.

VII. REQUIRED CONTEST PERSONNEL AND EQUIPMENT

A. Contest Coordinator

B. Judges - three (3) per heat

C. Two (2) timekeepers per level shall be designated who will record the time used by each contestant in delivering his/her speech. The timekeepers will note to the judges any undertime or overtime for which deductions should be made and inform the contestant of the amount of time remaining in minutes by using 5x7 cards with the numbers 4, 3, 2, 1 1/2, and 0 placed on them and shown to the contestant throughout the speech. Time shall be indicated to the contestant in a descending order.

D. Materials and equipment supplied by the committee:

1. Speaker's stand
2. Stopwatches for timekeepers
3. Table and chairs for three (3) judges
4. Rating sheets for judges furnished by Competitive Events Coordinator
5. Chairs for audience
6. One set of six 5x7 cards with one of the following numbers on each card: 4, 3, 2, 1, 1/2, and 0

VIII. CRITERIA FOR JUDGING

A. Contestants shall be ranked during heats and finals in numerical order on the basis of score to be determined by each judge without consultation with each other. The winner will be that contestant whose total score is the highest. Other placings shall be determined in the same manner.

B. Ratings will be based upon the following:

1. Topic Organization (Clear, Orderly)
   40 points
2. Developing Introduction (Interest Appeal)
   20 points
3. Topic Discussion (Factual Support)
   10 points
4. Conclusion 1 (Summary Appeal)
   10 points
5. Poise (Confident, Body Control, Posture)
   10 points
6. Language (Correct grammar, Clarity)
   10 points

C. Contest Coordinator will provide the Competitive Events Coordinator with a sealed packet containing the results.

D. All judges' ratings and results are to remain confidential.

TECHNOLOGY PROCESS DISPLAY

OVERVIEW: AIASA chapters entering the Technology Process Display contest are required to construct and display an industrial or technological process within a defined area.

I. CONTEST PURPOSE

The purpose of the Technology Process Display contest is to provide a means for AIASA chapters to demonstrate their knowledge of a process which they have researched by fabricating a display of the researched process.

II. ELIGIBILITY FOR ENTRY

A. Only AIASA chapters in good standing are eligible for entry.

B. Each chapter that is eligible may enter one display or exhibit for competition at the national contest level during the annual convention.

C. One entry per level.

III. LEVELS OF COMPETITION

Level I and Level II as described in General Rules.

IV. TIME LIMITATIONS

While this is not a "timed" event, all schedules must be adhered to as presented in Sections V and VI.

V. SPECIFIC REGULATIONS

A violation of regulations A or B will disqualify entry.

A. The exhibit size may not exceed 4'x4'x8' high.

B. The exhibit must depict some industry, industrial process, operation or application of methods or processes used in industry. (Applications of new technology to solve technical problems are encouraged.)

VI. PROCEDURE

A. Registration - Contest participants must register for the event in accordance with procedures established for each conference.

B. Exhibit must be entered during the assigned contest entry time.

C. Contest Coordinator must attach an entry number in the lower right corner of the exhibit. The contest number will be assigned during contest registration.

VII. SUPPLY LIST

A. Personnel

1. Contest Coordinator
2. Judges, three (3) per level
3. Helpers, two (2) per level

B. Equipment

1. Contest guidelines (3 per level)
2. Judges' rating sheets
3. Marking pens for judges, 12
4. Display tables for technology process display (a minimum of 12 4'x8' tables per level)
5. Table and chair for judges (3-person workstation per level)
6. List of entries

VIII. CRITERIA FOR JUDGING

A. The exhibit must be a chapter project.

B. Each exhibit shall have a description of the industry or industrial process it depicts. The number of chapter members participating in the total exhibit shall also be noted.

C. No students or advisor will be allowed to stand by exhibits during judging.

D. Rating will be based on the following:

Organization	20 points
Originality	20 points
Subject Coverage	30 points
Interest and Appeal	15 points
Workmanship	15 points