This curriculum guide on residential wiring for secondary students is one of six developed for inservice teachers at Marianas High School in Saipan. The guide provides the rationale, description, goals, and objectives of the program; the program of studies and performance objectives by levels; samples of lesson plans for effective delivery of instruction; and a listing of references. Concepts covered include fundamental concepts of electricity, performing basic experiments and manipulative skills involved in electrical occupations, principles and practices related to or applied to residential wiring, theoretical and technical instructions to further develop judgment and decision-making skills, electrical applications and installations directly related to residential wiring, and job-entry skills. Appended materials include job descriptions and tasks, sample lesson plans, sample attendance and progress charts, handouts, safety posters, and instructional resources. (CT)
CURRICULUM GUIDE

Electricity: Residential Wiring
Secondary Schools

This activity was supported in part by the U.S. Department of Education, Office of Vocational and Adult Education project titled, "Vocational Education Personnel Development in the Pacific Basin," Contract No. 300 790 436. However, opinions expressed herein do not necessarily reflect the position or policy of the U.S. Department of Education and no official endorsement by the U.S. Department of Education should be inferred.

August, 1980
STATE BOARDS FOR VOCATIONAL EDUCATION

Commonwealth of the Northern Marianas

Lorenzo LB. Cabrera, Chairperson
P.O. Box 514
Saipan, CM 96950

Joaquin S. Maglona, Vice-Chairperson
P.O. Box 997
Rota, CM 96950

Felicitas Abraham
P.O. Box 190 CHRB
Saipan, CM 96950

Sr. Mary Louis Balzarini, MMB
P.O. Box 136
Saipan, CM 96950

Dr. Ignacio Dela Cruz
P.O. Box 677
Saipan, CM 96950

Jesus Fiasao
P.O. Box 879
Saipan, CM 96950

Estanislao Hocog
c/o Mayor's Office
Tinian, CM 96950

Florin Mendiola-Hofschneider
San Jose Village
Tinian, CM 96950

Frankie Muna
P.O. Box 272
Saipan, CM 96950

Loran Koprowski
Executive Officer
Dept. of Education
Saipan, CM 96950

Michael White
Legal Counsel
P.O. Box 222 CHRB
Saipan, CM 96950

Trust Territory of the Pacific Islands

David Ramarui, Chairperson
Director, Bureau of Education
Saipan, CM 96950

Government of the Marshalls

Ms. Marie Madison
Public Service Commision
Majuro, Marshall Islands 96960

Government of Palau

Rev. Billy Kuartei, Vice-Chairperson
Emmaus High School
P.O. Box 4000
Koror, Palau 96940

Federated States of Micronesia

Kosrae

Mr. Lyndon Abraham
State Finance Officer
Lelu, Kosrae 96944

Ponape

Mr. Damien Sohl
Department of Education
Kolonia, Ponape 96941

Truk

Mr. Masasinge Eis
Department of Education
Moen, Truk 96942

Yap

Mr. John B. Rulmal
c/o P.O. Box 6157
Tamuning, Guam 96911

Cover designed by: Jesus S. Pua
Instructional Media Specialist

Lenny Diaz
Agriculture Instructor
Tinian School
This document, Curriculum Guide for Electricity (Residential Wiring) is one of several guides developed during the 1980 Summer Session held for in-service teachers at Marianas High School in Saipan. The in-service workshop was made possible through a federal project titled, Vocational Education Personnel Development in the Pacific Basin, under Section 135 of Title II of the Education Amendment Act of 1976 (P. L. 94-482).

Experienced teachers and administrators representing the secondary schools of the Commonwealth of the Northern Mariana Islands and the Trust Territory of the Pacific Islands developed the guide to establish curriculum standards for vocational education in their respective school systems. It is hoped that this guide will help teachers and administrators improve instruction as well as establish a base for future curriculum development efforts.

The guide provides the rationale, description, goals and objectives of the program; the program of studies and performance objectives by levels; samples of lesson plans for effective delivery of instruction; and a listing of references, supplies, and equipment.

Constructive comments and recommendations will be appreciated. These should be forwarded to either the Department of Education, Commonwealth of the Northern Mariana Islands or Bureau of Education, Trust Territory of the Pacific Islands, Directors of Vocational Education.

Herman Cabrera
Director, Vocational Education
Department of Education
Commonwealth of the Northern Mariana Islands

Loren Peterson
Director, Vocational Education
Bureau of Education
Trust Territory of the Pacific Islands
ACKNOWLEDGMENTS

This curriculum guide for Electricity is the result of the cooperative efforts of many people in the Commonwealth of the Northern Mariana Islands, Trust Territory of the Pacific Islands, University of Hawaii College of Education, and the State of Hawaii. Experienced teachers from the Commonwealth of the Northern Marianas and University of Hawaii personnel, have contributed toward the development of this guide. However, this guide is for both the Commonwealth of the Northern Mariana Islands and the Trust Territory of the Pacific Islands. The following persons are acknowledged as participants, consultants, evaluators, and support staff for the development of this guide.

TEACHERS

Jose C. Camacho
Jorge G. Guevara
Rosiky F. Camacho
Juan S. Pua

CONSULTANT-EVALUATORS

Herman Cabrera, SCVE/CNMI
Dan Hinkfuss, SVES/TRUK
David Ikeda, UH
Frank Kanzaki, UH
Loren Peterson, SDVE/TTPI

Edward Gallant, SVES/YAP
Ruth Hock, UH
Kenneth Kameoka, UH
Lincoln Kumai, UH
Robert Reed, UH

SUPPORT STAFF

Sue T. Ikertang/TTPI
Connie Sablan/CNMI
George Sablan/CNMI
INTRODUCTION

Rationale

The dependence on electrical power by our technological society is so evident that there is very few individuals who can imagine a world without electricity. And yet, the average person is basically illiterate in understanding this vital power source. The result is that many people do not realize the significance and the implications of electrical power in their daily lives as well as in the career opportunities that are available to them.

In the Commonwealth of the Northern Mariana Islands (CNMI) and the Trust Territory of the Pacific Islands (TTPI), electrical power play a vital role in their socioeconomic development plans. The large volume of construction that is currently taking place and also those in the projected plans will require additional electrical power and skilled electrical workers.

In a report prepared by Robert Nathan Associates of Washington, D.C., 1977, states that:

The large volume of construction that is indicated in the Socioeconomic Plan will strain the capabilities of both the local construction industry and the government. Of these two, the governmental constraint is more likely to be serious and longer in duration. Contractors, skilled workers, and building materials can and probably will be imported rapidly enough to make this a temporary constraint, if government capabilities in decision making and regulation of labor permits could be sharply expanded and made more effective.

It is obvious, even from casual observation and inquiry, that there is a lack of local skilled workers. Most of the skill trade workers are imported alien workers.

The Trust Territory Advisory Council for Vocational Education in its 10th Annual Report stated that with the changing emphasis from government to private employment, it is essential that vocational education be the means whereby students in high schools, which has been the principal area for skill development, acquire saleable skills for direct entry into the labor market. The Council encourages vocational administrators, counselors and teachers to recruit in a positive manner those students who would derive the most benefits from these programs.
The Electricity Program is a sequentially developed program to help students explore the fields of electricity as well as to help interested students who have the desire and capabilities with skills, knowledge and attitudes necessary for entry level employment.

With the every increasing use of electrical appliances and equipment, and the number of new dwellings being built in the Marianas and the Trust Territory, it has become evident that the trend towards importing foreign workers will be on the decline if the educational system can provide the industry with trained and skilled workers. This shift will probably add some strength and stability into our economy, as well as providing our youths with the type of employment opportunities that will satisfy their needs as well as the needs of our islands.

In order to insure that our youths are properly trained and prepared for entry level employment in the electrical wiring industry, we have attempted to develop a common curriculum guide that will meet these needs.

This guide will assist the instructor/teacher to present lessons and shop practices in the most appropriate and efficient manner.

Description

This program is a tri-level secondary school curriculum in Electricity, with emphasis in Residential Wiring.

The first level covers the introductory course where the emphasis are on learning the fundamental concepts of electricity, and performing basic experiments and manipulative skills involved in electrical occupations.

The second level covers the principles and practices which are related to or applied to residential wiring. Theoretical, technical, and related instructions are stressed to further develop judgment and decision making skills.

The third and final level, covers electrical applications and installations which are directly related to residential wiring. Job entry skills are stressed during this final course.

Goal

The goals of the program are to provide training through classroom and shop experiences to develop manipulative skills, safety practices, acceptable work habits, and attitudes for the purpose of gainful and
<table>
<thead>
<tr>
<th>TABLE OF CONTENTS</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOREWORD</td>
<td>i</td>
</tr>
<tr>
<td>ACKNOWLEDGMENT</td>
<td>ii</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>PROGRAM OF STUDIES</td>
<td>4</td>
</tr>
<tr>
<td>COURSE OUTLINE LEVEL I</td>
<td>5</td>
</tr>
<tr>
<td>COURSE OUTLINE LEVEL II</td>
<td>37</td>
</tr>
<tr>
<td>COURSE OUTLINE LEVEL III</td>
<td>65</td>
</tr>
<tr>
<td>APPENDICES</td>
<td>82</td>
</tr>
<tr>
<td>APPENDIX A JOB DESCRIPTION</td>
<td>83</td>
</tr>
<tr>
<td>APPENDIX B RESIDENTIAL WIRING TASKS</td>
<td>85</td>
</tr>
<tr>
<td>APPENDIX C SAMPLE LESSON PLANS</td>
<td>87</td>
</tr>
<tr>
<td>APPENDIX D SAMPLE ATTENDANCE AND PROGRESS CHARTS</td>
<td>129</td>
</tr>
<tr>
<td>APPENDIX E HANDOUTS</td>
<td>142</td>
</tr>
<tr>
<td>APPENDIX F SAFETY POSTERS</td>
<td>157</td>
</tr>
<tr>
<td>APPENDIX G INSTRUCTIONAL RESOURCES</td>
<td>160</td>
</tr>
<tr>
<td>BIBLIOGRAPHY</td>
<td>176</td>
</tr>
<tr>
<td>GLOSSARY</td>
<td>179</td>
</tr>
</tbody>
</table>
meaningful employment. The program has identified and sequenced a course of study that would be common to a wide range of occupations in the electrical trades cluster.

Objectives

The objectives of this program are as follows:

1. Develop skills and ability for occupational competency.
2. Develop attitudes required for entry level employment and advancement.
3. Develop knowledge and habits to perform tasks safely and efficiently.
4. Develop social traits that would be acceptable in functioning in our society.
5. Assist students in mastering basic literacy skills required to meet job specifications.
6. Provide the industry, community, and nation with a trained work force which will attract and promote economic and industrial development.

Objectives are prescribed so both student and teacher can assess the knowledge, skills, and attitudes gained from this course. By prescribing objectives, both different student characteristics and special needs students can be met using this same guide.

This guide should provide a more effective teaching plan and an accountability system would also be implemented. The basic plan is to train students to acquire saleable/marketable skills to satisfy their needs as well as the needs of the industry, community, and nation.

It should be noted that the success of this program is dependent on the quality of the general education and related courses.
PROGRAM OF STUDIES
LEVEL I

A. COURSE TITLE: INTRODUCTION TO ELECTRICITY

B. COURSE DESCRIPTION

This is a one year course that will enable the student to learn about electrical theories, such as voltage, current, and resistance and their relationship to each other. The course covers safety practices, applications of electricity in our daily lives, and the use and care of test instruments.

Practical applications include the use of handtools, test instruments, experimenting, designing, constructing and testing electrical devices and circuits.

C. GOALS

The goals of this course are to introduce the student to the world of electricity and the various opportunities of a career in this broad field. Also to develop skills, knowledge and attitudes that will enhance the student to cope in the highly technological society that we live in today.

D. COURSE OBJECTIVES

1. Appraise the opportunities of a trade in residential wiring and its requirements for employment.

2. Demonstrate habits which are conducive to learning.

3. Explain the importance of practicing safe working habits.

4. Specify the tools most commonly used in the electrical wiring industry.

5. Explain the five sources of electricity.

6. Explain and discuss the distribution system from the power plant to the resident.

7. Solve electrical problems using Ohm's Law.

8. Explain the basic principles of magnetism.

9. Explain the use of three different types of diagrams used in electrical wiring.
10. Install wiring using low voltage equipment.
11. Select the proper scale when utilizing test instruments.
12. Identify commonly used electrical symbols.
13. Demonstrate their ability to use ampacity tables in selecting conductors for general wiring.
14. Select and apply different techniques of splicing conductors.
15. Classify and identify electrical wiring devices and materials.

E. COURSE OUTLINE

*1. Career Orientation
  a. Job Description
  b. Entry level requirement
  c. Job ethics
  d. Working conditions
  e. Job opportunities

*2. Shop Orientation
  a. Shop policy
  b. Introduction to course content
  c. Grading policy
  d. Location of books and references
  e. Shop layout
  f. Location of tools

*3. Safety
  a. Safety program
  b. First aid
  c. Ventilation and lighting
  d. Material handling and storage
  e. Location of fire extinguisher

*4. Use and Care of Electrical Wiring Tools
  a. Screwdriver
  b. Phillips screwdriver
  c. Knife
  d. Diagonal pliers
  e. Long nose pliers
  f. Side cutting pliers/Lineman's pliers
  g. Channel lock pliers
h. Torpedo level
i. Tape rule
j. Folding rule
k. Chisels
l. Hammer
m. Keyhole saw
n. Wire stripper
o. Hack saw
p. Vise grip pliers
q. Tool pouch
r. Fish tape
s. Portable electric drill

5. Sources of Electricity
   a. Friction
   b. Chemical
   c. Magnetism
   d. Pressure
   e. Light
   f. Heat

6. Electrical Distribution
   a. Power plant
   b. Transmission lines
   c. Distribution lines
   d. Services

7. Basic Electricity DC
   a. Electron Theory
   b. Atomic Theory
   c. Batteries
   d. Conductivity of materials
   e. Ohm's Law
   f. Series circuit
   g. Parallel circuit
   h. Combination circuit
   i. Watts/power

8. Magnetism
   a. Laws of magnetism
   b. Electromagnetism
   c. DC generator

*9. Electrical Diagrams
   a. Schematic diagram
b. Wiring diagram
c. One-line diagram

*10. Low Voltage Circuits
   a. Use of low voltage circuits
   b. Procedures in wiring signal circuits
   c. Operation of signal devices
   d. Signal circuit equipment

*11. Use and Care of Test Instruments and Equipment
   a. Handling and transporting meters
   b. Zeroing meters
   c. Scale setting
   d. Identifying polarity
   e. Measuring voltage
   f. Measuring current
   g. Measuring resistance
   h. Proper storing

*12. Identifying Electrical Symbols
   a. Single pole switch
   b. Double pole switch
   c. Three-way switch
   d. Four-way switch
   e. Duplex receptacle
   f. Special purpose receptacle
   g. Split circuit receptacle
   h. Clock outlet
   i. Floor outlet
   j. Lighting outlet
   k. Lighting panel
   m. Low voltage push button
   n. Lampholder
   o. Weather proof receptacle
   p. Fan outlet
   q. Junction box
   r. Bell and buzzer
   s. Transformer

*13. Electrical Conductors and Insulators
   a. Importance of conductors and insulators
   b. Conductor resistance
   c. Conductor materials
   d. Conductor length
   e. Sizing
   f. Ampacity
g. Use of tables and charts

*14. Electrical Terminations
   a. Pigtail splices
   b. Tee splices
   c. Western Union connection
   d. Terminal screw connection
   e. Solderless connections

15. Electrical Wiring Devices and Materials
   a. Classification
   b. Switches
   c. Receptacles
   d. Lampholders
   e. Junction boxes

16. Guest Speakers
   a. Government
   b. Industry
   c. Professionals
   d. Other Instructors

17. Field Trips
   a. Power plant
   b. Housing project under construction
   c. Commercial and industrial installation

F. METHOD OF INSTRUCTION
   1. Lecture
   2. Lecture/Demonstration
   3. Audio/Visual Aids
   4. Field Trips
   5. Guest Speakers

G. METHOD OF EVALUATION
   1. Written Examination
   2. Oral
   3. Attendance
   4. Performance/Application
   5. Classroom Participation
H. TEXT AND REFERENCES

1.
2.
3.

I. CLASSROOM EQUIPMENT

1. Overhead Projector
2. 16 mm Projector
3. Colored Chalk

*NOTE: Designates subjects which are covered in one semester.
LEVEL I  INTRODUCTION TO ELECTRICITY
Unit: 1  CAREER ORIENTATION

Major Objective: Appraise the opportunities of a trade in residential wiring and its requirements for employment.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Job description</td>
<td>Describe what the residential electrician does</td>
<td>Lecture</td>
</tr>
<tr>
<td></td>
<td>Determine the age and health requirements to qualify to be an electrician.</td>
<td>Lecture guest speaker/discussion</td>
</tr>
<tr>
<td>b. Entry level requirements</td>
<td>Discuss the type of ethics that an electrician should be familiar with</td>
<td>Lecture</td>
</tr>
<tr>
<td></td>
<td>Determine if the working conditions of an electrician is favorable for their choice of occupation.</td>
<td>Lecture guest speaker from industry</td>
</tr>
<tr>
<td>c. Job ethics</td>
<td></td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td>d. Working conditions</td>
<td></td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td>Describe the possibilities for advancement in the field of electricity.</td>
<td>Lecture/student assignment (interview)</td>
</tr>
<tr>
<td>e. Job opportunities</td>
<td></td>
<td>Lecture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Guest speaker/discussion</td>
</tr>
</tbody>
</table>
# LEVEL I  INTRODUCTION TO ELECTRICITY

## Unit: 2  SHOP ORIENTATION

**Major Objective:** Demonstrates habits which are conducive to learning.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Shop policy</td>
<td>Discuss various aspects of rules and regulations of the shop and classroom.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td>b. Introduction of course content</td>
<td>Assess what is to be learned in the program of study.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td>c. Grading policy</td>
<td>Determine methods used in grading.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td>d. Location of books and references</td>
<td>Make maximum use of learning resources.</td>
<td>Lecture/tour of library</td>
</tr>
<tr>
<td>e. Shop layout</td>
<td>Identify areas that are used as aisles, work-stations, construction areas, tools and material storage.</td>
<td>Lecture/tour</td>
</tr>
<tr>
<td>f. Location of tools</td>
<td>Identify area designated as tool room and state procedure in acquiring tools for shop use.</td>
<td>Lecture/tour</td>
</tr>
</tbody>
</table>
LEVEL I  INTRODUCTION TO ELECTRICITY
Unit:  3 SAFETY

Major Objective:  Explain the importance of practicing safe working habits.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO DO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Safety program</td>
<td>Pass an examination on safety with 100% accuracy.</td>
<td>Lecture/demonstration/display posters.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Handout # 12</td>
</tr>
<tr>
<td>b. First aid</td>
<td>List the emergency first aid procedure.</td>
<td>Lecture/demonstration Handout</td>
</tr>
<tr>
<td>c. Ventilation and lighting</td>
<td>Explain how improper ventilation and lighting can be hazardous to work condition.</td>
<td>Guest speaker (fire dept.)</td>
</tr>
<tr>
<td>d. Material handling</td>
<td>Develop proper lifting skills and procedures for handling chemicals.</td>
<td>Lecture/Demonstration</td>
</tr>
<tr>
<td>storage</td>
<td></td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td>e. Location of fire</td>
<td>Identify the location of the nearest fire extinguisher and state type of fire it can be used on.</td>
<td>Guest speaker (Fire dept.)</td>
</tr>
<tr>
<td>extinguishers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## LEVEL I INTRODUCTION TO ELECTRICITY

Unit: 4 USE AND CARE OF ELECTRICAL WIRING TOOLS

**Major Objective:** Specify the tools most commonly used in the electrical industry.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO DO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Screw driver</td>
<td>Demonstrate the proper use and care of screw drivers.</td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td>b. Phillips screw driver</td>
<td>Demonstrate the proper use and care of phillips screw drivers.</td>
<td>Transparency TM - 1 - 2</td>
</tr>
<tr>
<td>c. Knife</td>
<td>Demonstrate the proper use and care of knives.</td>
<td></td>
</tr>
<tr>
<td>d. Diagonal pliers</td>
<td>Demonstrate the proper use and care of the diagonal pliers.</td>
<td></td>
</tr>
<tr>
<td>e. Long nose pliers</td>
<td>Demonstrate the proper use and care of the long nose pliers.</td>
<td></td>
</tr>
<tr>
<td>f. Side cutting/lineman's pliers</td>
<td>Demonstrate the proper use and care of the lineman's plier.</td>
<td></td>
</tr>
</tbody>
</table>
## LEVEL I UNIT 4 USE AND CARE OF ELECTRICAL WIRING TOOLS

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>g. Channel lok pliers</td>
<td>Demonstrate the proper use and care of the channel lok pliers.</td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td>h. Torpedo level</td>
<td>Demonstrate the proper use and care of the torpedo level.</td>
<td>Transparency TM - 1 - 2</td>
</tr>
<tr>
<td>i. Tape rule</td>
<td>Demonstrate the proper use and care of the tape rule.</td>
<td></td>
</tr>
<tr>
<td>j. Folding rule</td>
<td>Demonstrate the proper use and care of the folding rule.</td>
<td></td>
</tr>
<tr>
<td>k. Chisels</td>
<td>Demonstrate the proper use and care of chisels.</td>
<td></td>
</tr>
<tr>
<td>l. Hammer</td>
<td>Demonstrate the proper use and care of the hammer.</td>
<td></td>
</tr>
<tr>
<td>m. Keyhole saw</td>
<td>Demonstrate the proper use and care of the keyhole saw.</td>
<td></td>
</tr>
<tr>
<td>n. Wire stripper</td>
<td>Demonstrate the proper use and care of the wire stripper.</td>
<td></td>
</tr>
<tr>
<td>o. Hack saw</td>
<td>Demonstrate the proper use and care of the hack saw.</td>
<td></td>
</tr>
<tr>
<td>p. Vise-grip pliers</td>
<td>Demonstrate the proper use and care of the vise-grip pliers.</td>
<td></td>
</tr>
<tr>
<td>q. Tool pouch</td>
<td>Demonstrate the proper use and care of the tool pouch.</td>
<td></td>
</tr>
</tbody>
</table>
LEVEL I  UNIT 4 USE AND CARE OF ELECTRICAL WIRING TOOLS

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>r. Fish tape</td>
<td>Demonstrate the proper use and care of the fish tape.</td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td>s. Portable electric</td>
<td>Demonstrate the proper use and care of portable electric drills.</td>
<td>Transparency TM - 1 - 2</td>
</tr>
<tr>
<td>drill</td>
<td>Identify and name each of the tools above.</td>
<td></td>
</tr>
</tbody>
</table>
## LEVEL I INTRODUCTION TO ELECTRICITY

**Unit:** 5 SOURCES OF ELECTRICITY

**Major Objective:** Give examples of five sources of electricity and explain how electricity is produced using those sources.

### SUB-UNITS PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO DO)

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Friction</td>
<td>Explain how electricity can be produced by friction.</td>
<td>Lecture/discussion perform experiment (static)</td>
</tr>
<tr>
<td>b. Chemical</td>
<td>Explain how electricity can be produced by chemicals.</td>
<td>Lecture/discussion perform experiment (battery) Transparency</td>
</tr>
<tr>
<td>c. Magnetic</td>
<td>Explain how electricity can be produced by magnetism.</td>
<td>Lecture/discussion perform experiment (coil, magnet, and galvanometer) Transparency</td>
</tr>
<tr>
<td>d. Pressure</td>
<td>Explain how electricity can be produced by pressures.</td>
<td>Lecture/discussion ( Phonograph crystal cartridge and scope) Transparency</td>
</tr>
<tr>
<td>e. Light</td>
<td>Explain or give an example of a form of electricity that is produced by light.</td>
<td>Lecture/discussion perform experiment with photo-cell.</td>
</tr>
</tbody>
</table>
### LEVEL I UNIT 5 SOURCES OF ELECTRICITY

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>f. Heat</td>
<td>Explain how electricity is produced by applying heat.</td>
<td>Lecture/demonstration perform experiment with a thermocouple Transparency</td>
</tr>
<tr>
<td>g. Electricity</td>
<td>List six benefits derived from electricity.</td>
<td>Lecture/discussion Benefits: Power, Heat, Cooling, communications, Special controls</td>
</tr>
</tbody>
</table>
**Major Objective:** Explain and discuss about the electrical distribution system from the power plant to the resident.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO DO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Power plant</td>
<td>State the purpose and location of the nearest power plant in the area.</td>
<td>Lecture/transparency Lower Base, Tanapag</td>
</tr>
<tr>
<td>b. Transmission lines</td>
<td>Identify the transmission line when shown a distribution system.</td>
<td>Lecture/transparency</td>
</tr>
<tr>
<td>c. Distribution lines</td>
<td>Identify and differentiate between the distribution lines and transmission lines.</td>
<td>Lecture/transparency Voltage and distance</td>
</tr>
<tr>
<td>d. Services</td>
<td>Identify the service conductors on a drawing or an actual installation.</td>
<td>Lecture/transparency Last pole to resident</td>
</tr>
<tr>
<td>e. Feeder lines</td>
<td>Distinguish between feeder lines and service lines and state its function.</td>
<td>Lecture/transparency Conductor between service equipment and panelboard</td>
</tr>
</tbody>
</table>

FIELD TRIP TO POWER PLANT...
## Unit: 7 BASIC ELECTRICITY DC

### Major Objective:
Solve electrical problems using ohm's law.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO DO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Electron theory</td>
<td>Name the three particles that make up an atom.</td>
<td>Lecture/diagrams&lt;br&gt;Ref./Text p. 7&lt;br&gt;Home Appliance Servicing</td>
</tr>
<tr>
<td>b. Atomic theory</td>
<td>State the atomic theory</td>
<td>Lecture/diagrams&lt;br&gt;Ref./Text p. 7-9</td>
</tr>
<tr>
<td>c. Batteries</td>
<td>Define terms associated with batteries Primary cells, secondary cells, ampere-hour, battery ratings.</td>
<td>Lecture/display&lt;br&gt;Experiment: Science Act. 8 -&lt;br&gt;Ref./Text p. TM - 7 - 1, 7 - 2</td>
</tr>
<tr>
<td>d. Conductivity of</td>
<td>Classify conductivity of a given set of materials.</td>
<td>Lecture/demonstration&lt;br&gt;Ref./Text. p TM - 8</td>
</tr>
<tr>
<td>materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUB-UNITS</td>
<td>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</td>
<td>SUGGESTED LEARNING ACTIVITIES</td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>e. Ohm's Law</td>
<td>e. State the relationship between ohms, volts, and amperes.</td>
<td>e. Lecture/diagrams, TM2 &amp; 3</td>
</tr>
<tr>
<td></td>
<td>Manipulate symbols to solve problems when two known quantities are given.</td>
<td>Ref: Text, p. 5</td>
</tr>
<tr>
<td></td>
<td>State the importance of being able to apply ohm's law formulas to electric circuits.</td>
<td>Transparency, TM-9, 10</td>
</tr>
<tr>
<td></td>
<td>f. Explain the relationship of ohm's, volts, and amperes in a series circuit.</td>
<td>Lecture/diagrams</td>
</tr>
<tr>
<td></td>
<td>Solving problems associated with series circuits.</td>
<td>Ref: Text, p. 5</td>
</tr>
<tr>
<td></td>
<td>Draw diagrams of series circuits.</td>
<td></td>
</tr>
<tr>
<td>f. Series Circuit</td>
<td>g. Parallel Circuit</td>
<td>f. Lecture/diagrams</td>
</tr>
<tr>
<td></td>
<td>g. State the characteristics of parallel circuits.</td>
<td>Ref: Text, p. 10</td>
</tr>
<tr>
<td></td>
<td>Solve problems associated with parallel circuits.</td>
<td>Transparency TM 11, 12, 13</td>
</tr>
<tr>
<td></td>
<td>Draw diagrams of parallel circuits.</td>
<td>Lab./Shop: Wire lampholders in series and parallel and prove ohm's law.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Assignment sheet.</td>
</tr>
<tr>
<td>SUB-UNITS</td>
<td>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</td>
<td>SUGGESTED LEARNING ACTIVITIES</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>h. Combination Circuit</td>
<td><strong>h.</strong> State the characteristics of combination circuits. Solve problems associated with combination circuits. Draw diagrams of combination circuits.</td>
<td>h. Lecture/diagrams Ref: Text</td>
</tr>
<tr>
<td>i. Watts</td>
<td><strong>i.</strong> Define the following terms: power, watts. State the relationship between volts, amperes, and watts. Solve problems using the power formula.</td>
<td>i. Lecture Ref: Text, p. 8</td>
</tr>
</tbody>
</table>

h. Lecture/demonstration
## Major Objective:

Explain the basic principles of magnetism

### SUB-UNITS Performance Objectives

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Laws of magnetism</td>
<td>State the laws of magnetism</td>
</tr>
<tr>
<td>b. Electromagnetism</td>
<td>State some applications of electromagnetism and how it can be strengthened</td>
</tr>
<tr>
<td>c. DC Generator</td>
<td>Name the basic components of a dc generator and its function</td>
</tr>
</tbody>
</table>

### Suggested Activities

- Lecture/Demonstration with magnets, Ref./Text p. TM-___
- Lecture/Demonstration with coil, Ref./Text p. TM-___
- Lecture/discussion, Ref./Text p. TM-___

**Experiments:** SCIENCE ACT. 1-4-13

43
## Major Objective:
Explain the use of the three different types of diagrams used in electrical wiring.

### Performance Objectives
(THESA-_STUDENT WILL BE ABLE TO_)

<table>
<thead>
<tr>
<th>SUB-UNITs</th>
<th>PERFORMANCE OBJECTIVES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Schematic Diagram</td>
<td>Read and trace the flow of current on a schematic diagram.</td>
</tr>
<tr>
<td></td>
<td>Draw a schematic diagram of a light controlled by a switch.</td>
</tr>
<tr>
<td>b. Wiring diagram</td>
<td>Draw a wiring diagram of a light which is controlled by a switch.</td>
</tr>
<tr>
<td>c. One-line diagram</td>
<td>State the use of one-line diagram.</td>
</tr>
</tbody>
</table>
### Major Objective:
Install wiring using low voltage equipment.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Use of low voltage circuits</td>
<td>State the uses of low voltage circuits in residential wiring and other applications.</td>
<td>Lecture Ref: Text, p. 141-145</td>
</tr>
<tr>
<td>b. Procedure in wiring signal circuits</td>
<td>State the procedure in wiring signal circuits</td>
<td>Lecture/chalkboard drawing - stress three-step procedure Transparency TM-</td>
</tr>
<tr>
<td>c. Operation of signal devices</td>
<td>Name three different types of signal devices used in residential wiring</td>
<td>Lecture, display devices Transparency TM-</td>
</tr>
<tr>
<td>d. Signal circuit equipment</td>
<td>List the equipment and supplies needed for wiring a low voltage signal circuit</td>
<td>Lecture/display Ref: Text, p. 141</td>
</tr>
</tbody>
</table>
LEVEL I INTRODUCTION TO ELECTRICITY
Unit: USE AND CARE OF TEST INSTRUMENTS AND EQUIPMENT

Major Objective: Select the type of meter for determining voltage, ampere, resistance, and continuity.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Handling and transporting meters</td>
<td>State the importance of proper handling and transporting of meters.</td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td></td>
<td>Describe the reason for zeroing the meter</td>
<td>Ref: Text, p.</td>
</tr>
<tr>
<td>b. Zeroing the meter</td>
<td>Demonstrate the use of each scale on a meter.</td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td></td>
<td>Distinguish between positive terminals and negative terminals either through color code or symbols.</td>
<td>Student application</td>
</tr>
<tr>
<td>c. Scale setting</td>
<td></td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td></td>
<td>Demonstrates the ability to safely and properly measure voltage across a load.</td>
<td>Student application</td>
</tr>
<tr>
<td>d. Identifying polarity</td>
<td></td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td>e. Measuring voltage</td>
<td></td>
<td>Demonstration/application</td>
</tr>
</tbody>
</table>

Volt meter
<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>f. Measuring current</td>
<td>Demonstrate the ability to safely and properly measure current on a given load.</td>
<td>Demonstration/application Ammeter, amprobe</td>
</tr>
<tr>
<td>g. Measuring resistance</td>
<td>Demonstrate the ability to safely and properly measure resistance of a circuit.</td>
<td>Demonstration/application Ohmmeter</td>
</tr>
<tr>
<td>h. Storing</td>
<td>Explain the reasons for storing meters in a prescribed area.</td>
<td>Lecture/discussion Cool and dry area</td>
</tr>
</tbody>
</table>
**LEVEL I  INTRODUCTION TO ELECTRICITY**

**Unit: 12  ELECTRICAL SYMBOLS**

**Major Objective:** Identify commonly used electrical symbols

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Single pole switch</td>
<td>Identify a single pole switch on an electrical plan.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td>Draw the symbol for a single pole switch.</td>
<td>Handout # 2</td>
</tr>
<tr>
<td>b. Double pole switch</td>
<td>Identify a double pole switch on an electrical plan.</td>
<td>Ref: Text, p. 26-33</td>
</tr>
<tr>
<td></td>
<td>Draw the symbol for a double pole switch.</td>
<td>Transparency TM-17</td>
</tr>
<tr>
<td>c. Three-way switch</td>
<td>Identify a three-way switch on an electrical plan.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Draw the symbol for a three-way switch.</td>
<td></td>
</tr>
</tbody>
</table>
### LEVEL I UNIT 12 ELECTRICAL SYMBOLS

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>d. Four-way switch</td>
<td>Identify a four-way switch on an electrical plan</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td>Draw the symbol for a four-way switch.</td>
<td>Handout # 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref: Text, p. 26-33</td>
</tr>
<tr>
<td>e. Duplex receptacle</td>
<td>Identify a duplex receptacle on an electrical plan.</td>
<td>Transparency TM-17</td>
</tr>
<tr>
<td></td>
<td>Draw a symbol for a duplex receptacle.</td>
<td></td>
</tr>
<tr>
<td>f. Special purpose receptacle</td>
<td>Identify a special purpose receptacle on an electrical plan.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Draw the symbol for a special purpose receptacle.</td>
<td></td>
</tr>
<tr>
<td>g. Split circuit receptacle</td>
<td>Identify a split circuit receptacle on an electrical plan.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Draw the symbol for a split circuit receptacle.</td>
<td></td>
</tr>
<tr>
<td>h. Clock outlet</td>
<td>Identify a clock outlet on an electrical plan.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Draw the symbol for a clock outlet.</td>
<td></td>
</tr>
<tr>
<td>i. Floor outlet</td>
<td>Identify a floor outlet on an electrical plan.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Draw the symbol for a floor outlet.</td>
<td></td>
</tr>
</tbody>
</table>
### Level I Unit 12 Electrical Symbols

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>j. Lighting outlet</td>
<td>Identify a lighting outlet on an electrical plan.</td>
<td>Lecture/discussion Handout #2</td>
</tr>
<tr>
<td></td>
<td>Draw the symbol for a lighting outlet.</td>
<td>Ref: Text, p. 26-33</td>
</tr>
<tr>
<td>k. Lighting panel</td>
<td>Identify a lighting panel on an electrical plan.</td>
<td>Transparency TM-17</td>
</tr>
<tr>
<td></td>
<td>Draw the symbol for a lighting panel.</td>
<td></td>
</tr>
<tr>
<td>l. Low voltage pushbutton</td>
<td>Identify a symbol of a low voltage pushbutton on an electrical plan.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Draw the symbol for a low voltage pushbutton.</td>
<td></td>
</tr>
<tr>
<td>m. Lampholder</td>
<td>Identify a symbol for a lampholder.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Draw a symbol for a lampholder.</td>
<td></td>
</tr>
<tr>
<td>n. Weatherproof receptacle</td>
<td>Identify a weatherproof receptacle on an electrical plan.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Draw the symbol for a weatherproof receptacle.</td>
<td></td>
</tr>
<tr>
<td>o. Fan outlet</td>
<td>Identify a fan outlet on an electrical plan.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Draw the symbol for a fan outlet.</td>
<td></td>
</tr>
<tr>
<td>SUB-UNITS</td>
<td>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</td>
<td>SUGGESTED LEARNING ACTIVITIES</td>
</tr>
<tr>
<td>-------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>p. Junction box</td>
<td>Identify a junction box on an electrical plan.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Draw the symbol for a junction box.</td>
<td></td>
</tr>
<tr>
<td>q. Bell or buzzer</td>
<td>Identify the symbol for a bell or buzzer on an electrical plan.</td>
<td></td>
</tr>
<tr>
<td>r. Transformer</td>
<td>Identify a symbol for a transformer.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Draw the symbol for a transformer.</td>
<td></td>
</tr>
</tbody>
</table>
**Major Objective:** Demonstrate their ability to use ampacity tables in selecting conductors for general wiring.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Importance of conductors and insulators</td>
<td>Distinguish conductors from insulators.</td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Display various conductors and insulators</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref: Text, p.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transparency TM-18</td>
</tr>
<tr>
<td>b. Conductor resistance</td>
<td>State the factors that affects resistance of conductors and insulators.</td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref: Text, p.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC, Chapter 9, p. 587, Art. 310</td>
</tr>
<tr>
<td>c. Conductor materials</td>
<td>State the types of materials most commonly used in electrical wiring.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref: Text, p.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Copper, aluminum</td>
</tr>
<tr>
<td>d. Conductor length</td>
<td>Discuss the factors which determine resistance to its length.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Experiment with various lengths of conductors.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref: Text, p.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC, Chapter 9, Table 8.</td>
</tr>
<tr>
<td>SUB-UNITS</td>
<td>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</td>
<td>SUGGESTED LEARNING ACTIVITIES</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>e. Sizing</td>
<td>State the methods used in sizing electrical conductors.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Demonstrate with wire gauge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref: Text, p.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC, Chapter 9, Table 8</td>
</tr>
<tr>
<td>f. Ampacity</td>
<td>Use the ampacity table to determine the size of conductor for a given load.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC, Art. 310</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref: Text, P.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC, Table 310-16, 17, 18, 19</td>
</tr>
<tr>
<td>g. Use of tables and charts</td>
<td>Select the proper table or chart to determine conductor size.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC, Art. 310, 400, Chapter 9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref: Text, p.</td>
</tr>
</tbody>
</table>
**LEVEL I**  INTRODUCTION TO ELECTRICITY  
Unit: 14  ELECTRICAL TERMINATIONS

**Major Objective:** Select and apply the different techniques of splicing conductors.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Pigtail splice</td>
<td>Demonstrate the proper method of forming a pigtail splice.</td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td>b. Tee splice</td>
<td>Demonstrate the proper method of forming a tee splice.</td>
<td>Ref: Text, p. 147-173</td>
</tr>
<tr>
<td>c. Western union splice</td>
<td>Demonstrate the proper method of forming a western union splice.</td>
<td></td>
</tr>
<tr>
<td>d. Terminal screw connection</td>
<td>Demonstrate the proper method of forming terminal screw connections.</td>
<td></td>
</tr>
<tr>
<td>e. Solderless connections</td>
<td>Demonstrate the proper method of making a solderless connection</td>
<td></td>
</tr>
<tr>
<td>f. Reinsulating splices</td>
<td>Demonstrate the proper method of reinsulating splices.</td>
<td>Student application</td>
</tr>
</tbody>
</table>
Major Objective: Classify and identify electrical devices and materials.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Classification</td>
<td>State the factors which determine the classification of devices and materials.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use, rating, size</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref: Text, p. 135</td>
</tr>
<tr>
<td>b. Switches</td>
<td>List the four types of switches most commonly used in residential wiring.</td>
<td>Lecture/display</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref: Text, p. 111-138</td>
</tr>
<tr>
<td>c. Receptacles</td>
<td>State the applications for various types of receptacles.</td>
<td>Lecture/display</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref: Text, p. 35-38</td>
</tr>
<tr>
<td></td>
<td></td>
<td>House wiring simplified</td>
</tr>
<tr>
<td>d. Lampholders</td>
<td>Distinguish between keyless and pull-chain lampholders.</td>
<td>Lecture/display</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref: Text, p.</td>
</tr>
<tr>
<td>e. Junction boxes</td>
<td>Discuss the process of selecting the proper size junction box for a simple lighting circuit.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art. 370</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref: Text, p. 24-25</td>
</tr>
</tbody>
</table>
LEVEL II

A. COURSE TITLE: ELECTRICAL PRINCIPLES AND PRACTICES

B. COURSE DESCRIPTION

This intermediate course covers principles and wiring practices which are utilized in electrical circuits. Safety practices as well as code requirements and wiring techniques are stressed.

Students are taught the procedures in making electrical terminations, selecting overcurrent devices, and wiring various electrical circuits utilizing approved wiring methods and materials.

C. GOALS

The goals of this course are to provide the means by which the student can understand the principles and practices that are essential for pursuing a career in the residential wiring industry. The student will apply skills that can be applied to a wide range of occupations in the electrical field.

D. COURSE OBJECTIVES

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

1. Recommend practices that promote learning
2. Develop habits that prevent accidents
3. Explain the difference between Direct Current and Alternating Current and its applications
4. Utilize the NEC and Standards in wiring practices
5. Explain the procedure for calculating the number of lighting circuits required for a residential dwelling
6. Demonstrate and apply various electrical terminations
7. Utilize the proper electrical symbols when drawing electrical diagrams
8. Select and explain the use of electrical wiring devices and materials
9. Explain the purpose and principles of overcurrent protection
10. Apply wiring methods recognized by the Code
11. Determine the proper size conductor for grounding an electrical system
12. Determine and select the proper materials for a service entrance
13. Analyze basic wiring problems in lighting circuits and correct them.

E. COURSE OUTLINE

1. Shop Orientation
1. Introduction to course content
2. Safety
   a. Safety program
   b. First aid
   c. Ventilation and lighting
   d. Material handling and storage
   e. Location of fire extinguishers
3. Basic Electrical Theory AC
   a. Uses of AC current
   b. Cycle
   c. Frequency
   d. Phase
   e. Voltages
   f. Transformers
   g. Inductance
   h. Capacitance
4. Introduction to the NEC and Standards
   a. Purpose of the NEC
   b. Scope
   c. Code arrangement
   d. Definitions
   e. Fundamental rules
   f. Interpretation
   g. Enforcement
   h. Examination of equipment for safety
   i. Wiring planning
   j. Revision
   k. History of the NEC
5. Electrical Blueprint Reading
   a. Introduction to blueprints
   b. Material description
   c. Scales
   d. Types of drawing
   e. Calculations
6. Electrical Terminations
   a. Types of splices
   b. Reinsulating splices
   c. Use of soldering iron and solder
   d. Use of crimping tools
   e. Use of terminal clips
   f. Preparing conductors for termination
   g. Use of split-bolt connectors

7. Electrical Diagrams
   a. Use of diagrams
   b. Symbols
   c. Single Pole
   d. Three-way
   e. Four-way
   f. Lighting circuit
   g. Combination of switch and pilot light

8. Electrical Wiring Devices and Materials
   a. Definition
   b. Switches
   c. Receptacles
   d. Lampholders
   e. Junction boxes
   f. Panelboards
   g. Conductors
   h. Cables
   i. Raceways
   j. Cords
   k. Attachment caps
   l. Fasteners

9. Overcurrent Protection
   a. Purpose
   b. Types
   c. Selection
   d. Usage

10. Wiring Methods
    a. Raceways
    b. Cables
    c. Selection and application of wiring method
11. Grounding
   a. Purpose
   b. Types of grounding
   c. Methods of grounding
   d. Bonding
   e. Selecting grounding and bonding conductors
   f. NEC requirements

12. Electrical Service Systems
   a. Types of services
   b. Parts of the service system
   c. Calculating service sizes
   d. Selecting service entrance materials
   e. Installing services
   f. NEC requirements

13. Troubleshooting Procedures
   a. Analyze electrical circuit
   b. Determine malfunction
   c. Restoring problem
   d. Retest

14. Guest Speakers
   a. Government
   b. Industry
   c. Business
   d. Other instructors

15. Field Trips

F. METHOD OF INSTRUCTIONS
   1. Lecture
   2. Lecture/Demonstration
   3. Audio/Visual Aids
   4. Guest Speakers
   5. Field Trips

G. METHOD OF EVALUATION
   1. Written Examination
   2. Oral
   3. Attendance
   4. Performance/Application
   5. Classroom Participation
H. TEXT AND REFERENCES

1. 
2. 
3. 

I. CLASSROOM EQUIPMENT

1. Overhead Projector
2. 16 mm Projector
3. Colored chalk
### Major Objective:
Demonstrate habits which are conducive to learning.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Shop policy</td>
<td>Discuss various aspects of rules and regulations of the shop and classroom.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td>b. Introduction of course content</td>
<td>Assess what is to be learned in the program of study.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td>c. Grading policy</td>
<td>Determine methods used in grading.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td>d. Location of books and references</td>
<td>Make maximum use of learning resources.</td>
<td>Lecture/tour of library</td>
</tr>
<tr>
<td>e. Shop layout</td>
<td>Identify areas that are used as aisles, workstations, construction areas, tool and material storage.</td>
<td>Lecture/tour</td>
</tr>
<tr>
<td>f. Location of tools</td>
<td>Identify area designated as toolroom and state procedure in acquiring tools for shop use.</td>
<td>Lecture/tour</td>
</tr>
</tbody>
</table>
LEVEL II  ELECTRICAL PRINCIPLES AND PRACTICES

Unit: 2 SAFETY

Major Objective: Explain the importance of practicing safe work habits.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety program</td>
<td>Pass an examination on safety with 100% accuracy.</td>
<td>Lecture/demonstration/display posters. Handout #12</td>
</tr>
<tr>
<td>First aid</td>
<td>List the emergency first aid procedure</td>
<td>Lecture/demonstration Handout Guest speaker (fire dept.)</td>
</tr>
<tr>
<td>Ventilation and lighting</td>
<td>Explain how improper ventilation and lighting can be hazardous to working conditions.</td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td>Material handling and storage</td>
<td>Develop proper lifting skills and procedures for handling chemicals.</td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td>Identification of fire extinguishers</td>
<td>Identify the location of the nearest fire extinguisher and state type of fire it can be used on.</td>
<td>Guest speaker (Fire dept.)</td>
</tr>
</tbody>
</table>

76
LEVEL II ELECTRICAL PRINCIPALS AND PRACTICES

Unit: 3 BASIC ELECTRICAL THEORY AC

Major Objective: Explain the difference between Direct Current and Alternating Current and its application.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Uses of AC current</td>
<td>State the reason why AC current is used more frequently than DC current in our daily lives.</td>
<td>Lecture/diagram/discussion Ref./Text. p.</td>
</tr>
<tr>
<td>b. Cycle</td>
<td>Define the term &quot;cycle&quot; and state the frequently used AC cycle.</td>
<td>Lecture/transparency/handout (scope) Ref./Text. p.</td>
</tr>
<tr>
<td>c. Frequency</td>
<td>Define frequency</td>
<td>Lecture/diagram/handout Ref./Text. p.</td>
</tr>
<tr>
<td>d. Phase</td>
<td>Define the term &quot;phase&quot; and state the type most commonly used in electrical wiring.</td>
<td>Lecture/handout</td>
</tr>
<tr>
<td>e. Voltage</td>
<td>State the behavior of voltage in AC with comparison to DC electricity.</td>
<td>Lecture/diagram/transparency Ref./Text. p.</td>
</tr>
<tr>
<td>SUB-UNITS</td>
<td>PERFORMANCE OBJECTIVES</td>
<td>SUGGESTED LEARNING ACTIVITIES</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------</td>
</tr>
<tr>
<td>g. Inductance</td>
<td>Explain the behavior of inductance in an AC circuit.</td>
<td>Lecture/diagram Ref./Text. p. Stress &quot;current lags voltage&quot;</td>
</tr>
<tr>
<td>h. Capacitance</td>
<td>Explain the behavior of a capacitive circuit.</td>
<td>Lecture/diagram Ref./Text. p. Stress &quot;current leads voltage&quot;</td>
</tr>
</tbody>
</table>
**Major Objective:** To utilize the NEC in wiring practices.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
</table>
| a. Purpose of the NEC | State the purpose of the NEC. | Lecture  
Ref: NEC, p. 1 Art. 90-1 |
| b. Scope | Identify those areas that are covered and those that are not covered by the NEC. | Lecture  
Ref: NEC, p. 1-2, Art. 90-2 |
| c. Code Arrangement | Explain how the code is arranged and state specific articles used in general wiring practices. | Lecture  
Ref: NEC, p. 2, Art. 90-3 |
| d. Definitions | Define terms used in the NEC which pertain to residential wiring. | Lecture  
Ref: NEC, p. 4-15, Art. 100 |
| e. Fundamental rules | State the difference between mandatory and recommended rules and its application. | Lecture  
Ref: NEC, p. 16, Art. 110 |
<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>f. Interpretation</td>
<td>State procedure for filing for a formal code interpretation.</td>
<td>Lecture</td>
</tr>
<tr>
<td></td>
<td>Name the agency who does the enforcement of the NEC in their area.</td>
<td>Lecture</td>
</tr>
<tr>
<td>g. Enforcement</td>
<td>List two agencies who does examination of equipment.</td>
<td>Lecture</td>
</tr>
<tr>
<td>h. Examination of Equipment</td>
<td>State reasons for adequate wiring planning.</td>
<td>Lecture</td>
</tr>
<tr>
<td>for safety</td>
<td></td>
<td>Ref: NEC, p. 2, Art. 90-6</td>
</tr>
<tr>
<td>i. Wiring Planning</td>
<td>State how often the Code is revised and the general purpose of revisions.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td>j. Revision of the NEC</td>
<td>Discuss the origin and history of the NEC.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td>k. History of the NEC</td>
<td></td>
<td>Student Assignments.</td>
</tr>
</tbody>
</table>
### Major Objective:

Explain the procedures for calculating the number of lighting circuits required for a residential dwelling.

### SUB-UNITS

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Introduction to blueprint reading</td>
<td>State the purpose of the blueprint.</td>
<td>Lecture/discussion Ref./Text. p. 25-65 Use real blueprints</td>
</tr>
<tr>
<td>b. Material description</td>
<td>Identify symbols found in blueprints.</td>
<td></td>
</tr>
<tr>
<td>c. Scales</td>
<td>Identify the types of materials used.</td>
<td></td>
</tr>
<tr>
<td>d. Types of drawings.</td>
<td>Identify the scale used on a blueprint.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>State the different types of drawings found in a set of blueprints.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUB-UNIT</td>
<td>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</td>
<td>SUGGESTED LEARNING ACTIVITIES</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>f. Calculation</td>
<td>Use the NEC to calculate various types of loads used in residential wiring.</td>
<td>Lecture/discussion&lt;br&gt;Ref./Text p.&lt;br&gt;NEC Chapter 9 Ex. B-1 p. 589&lt;br&gt;Student application—Use floor plan.&lt;br&gt;Lighting loads, small appliance, washers</td>
</tr>
</tbody>
</table>
## Unit: 6 Electrical Termination

**Major Objective:** Demonstrate and apply the various types of terminations used in electrical installations.

<table>
<thead>
<tr>
<th>Sub-Units</th>
<th>Performance Objectives (The student will be able to)</th>
<th>Suggested Learning Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Types of splices</td>
<td>List the various types of splices used in electrical installations.</td>
<td>Lecture/demonstration Ref./Text p. 147-173 Illustrations</td>
</tr>
<tr>
<td>b. Reinsulating</td>
<td>Explain the process used in reinsulating splices.</td>
<td>Lecture/demonstration Ref./Text p. 160-161</td>
</tr>
<tr>
<td>c. Use of soldering irons and soldering guns</td>
<td>Demonstrate the techniques of soldering splices.</td>
<td>Lecture/demonstration Ref./Text p. 151-153</td>
</tr>
<tr>
<td>d. Use of crimping tools</td>
<td>Demonstrate the use of the crimping tool.</td>
<td>Lecture/demonstration Ref./Text p. 148-149</td>
</tr>
<tr>
<td>a. Preparing conductors for termination</td>
<td>Prepare conductors for splicing</td>
<td>Lecture/demonstration Ref./Text p. 147 Stress preventing knicking conductors.</td>
</tr>
<tr>
<td>SUB-UNITS</td>
<td>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</td>
<td>SUGGESTED LEARNING ACTIVITIES</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-----------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>f. Use of terminal clips</td>
<td>State the reasons for using terminal clips</td>
<td>Lecture/display&lt;br&gt;Ref./Text p. 171-173&lt;br&gt;Stress: ease of attachment, limited space, saves time.</td>
</tr>
<tr>
<td>g. Use of wire nuts</td>
<td>Determine, select and apply the proper size of wire nuts to a pigtail splice.</td>
<td>Lecture/demonstration&lt;br&gt;Ref./Text p. 161-163&lt;br&gt;Stress: clockwise rotation, no bare conductors, tightness of wire nut.</td>
</tr>
<tr>
<td>h. Use of split-bolt connectors</td>
<td>State where split-bolt connectors are most frequently used and demonstrate ability to install split-bolt connectors.</td>
<td>Lecture/demonstration&lt;br&gt;Ref./Text p. 164-166&lt;br&gt;Stress: proper reinsulating techniques.</td>
</tr>
</tbody>
</table>
LEVEL II ELECTRICAL PRINCIPLES AND PRACTICES

Unit: 7 ELECTRICAL DIAGRAMS

Major Objective: Utilize proper electrical symbols when drawing electrical diagrams.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Use of diagram</td>
<td>State the use of a wiring diagram and a schematic diagram.</td>
<td>Lecture/illustration Ref./Text p.</td>
</tr>
<tr>
<td>b. Symbols</td>
<td>Draw and identify various symbols used in residential wiring.</td>
<td>Illustrate and explain single pole switch three-way switch four-way switch wire connection lampholder junction box pilot lite Ref./Text p. HO 1</td>
</tr>
<tr>
<td>c. Single pole switch</td>
<td>Construct a diagram of a single pole switch controlling one or more lites.</td>
<td>Lecture/diagram/discussion Ref./Text p. 111-112 HO 1</td>
</tr>
<tr>
<td>SUB-UNITS</td>
<td>PERFORMANCE OBJECTIVES</td>
<td>SUGGESTED LEARNING ACTIVITIES</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>d. Three-way switching</td>
<td>Construct a diagram using two three-way switches controlling one or more lites.</td>
<td>Lecture/diagram/discussion Ref./Text p. 115-121 HO 9</td>
</tr>
<tr>
<td>e. Four-way switching</td>
<td>Construct a diagram using two three-way and one four-way switch to control one or more lites.</td>
<td>Lecture/diagram/discussion Ref./Text p. 121-124 HO 10</td>
</tr>
<tr>
<td>g. Combination switch and pilot light</td>
<td>Construct a diagram of a switch with pilot light.</td>
<td>Lecture/diagram/discussion Ref./Text p. 130-132</td>
</tr>
</tbody>
</table>
Major Objective: Select and explain the use of electrical wiring devices and materials

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Definition</td>
<td>Define and describe the difference between wiring devices and materials.</td>
<td>Lecture/discussion&lt;br&gt;Suggest:&lt;br&gt;material overall term. Device Art. 100</td>
</tr>
<tr>
<td>b. Switches</td>
<td>Explain the function of a switch and name three types of switches used in residential wiring.</td>
<td>Lecture/discussion/display&lt;br&gt;Ref./Text p.&lt;br&gt;single pole, three-way four-way switches</td>
</tr>
<tr>
<td>c. Receptacles</td>
<td>Explain how receptacles are classified.</td>
<td>Lecture/display/discussion&lt;br&gt;Ref./Text p.&lt;br&gt;NEC Art 410 L</td>
</tr>
<tr>
<td>d. Lampholders</td>
<td>State the requirement for screw-shell type lampholders.</td>
<td>Lecture/display&lt;br&gt;NEC Art. 410-47</td>
</tr>
<tr>
<td>SUB-UNITS</td>
<td>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</td>
<td>SUGGESTED LEARNING ACTIVITIES</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------</td>
</tr>
<tr>
<td>e. Junction boxes</td>
<td>State how boxes are classified and utilized.</td>
<td>Lecture/display</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text p.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art. 370-2, 3, 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Table 370-6(a)</td>
</tr>
<tr>
<td>f. Panelboards</td>
<td>Define panelboard</td>
<td>Lecture/display</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text p.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art. 100, Art. 384</td>
</tr>
<tr>
<td>g. Conductors</td>
<td>Utilize the NEC to indicate by trade name various conductors and its application.</td>
<td>Lecture</td>
</tr>
<tr>
<td>h. Cables</td>
<td>State the use of various types of cables.</td>
<td>NEC Table 310-13</td>
</tr>
<tr>
<td>i. Raceways</td>
<td>Specify the types of raceways most commonly used in residential wiring.</td>
<td>Lecture/display/discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text p.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art. 336, 333, 338, 339</td>
</tr>
<tr>
<td>j. Cords</td>
<td>Utilize the NEC to select cords and cables for specific applications.</td>
<td>Lecture/field trip</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art. 346, 347, 348</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text p.</td>
</tr>
<tr>
<td>k. Attachment caps</td>
<td>Identify attachment caps and install/attach to flexible cords.</td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td>l. Fasteners</td>
<td>List the various types of fasteners used in electrical wiring.</td>
<td>Lecture/display</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text p.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stress: wood screws, sheetmetal screws, lag screws, machine screws, stove bolts, power fasteners.</td>
</tr>
</tbody>
</table>
LEVEL II ELECTRICAL PRINCIPLES AND PRACTICES

Unit: 9 OVERCURRENT PROTECTION

Major Objective: Explain the purposes and principles of overcurrent protection.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. purpose</td>
<td>State the purpose of installing overcurrent protection in circuits.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NECT Art. 240</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text p. 282</td>
</tr>
<tr>
<td>b. Types of overcurrent protection</td>
<td>Identify various types of overcurrent devices.</td>
<td>Lecture/display</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transparency 3 &amp; 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text p. 282-286</td>
</tr>
<tr>
<td>c. Selection</td>
<td>Utilize the Code to select the properly rated overcurrent device to protect a given size conductor.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art. 310 p. 132-135</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text p. 286</td>
</tr>
<tr>
<td>d. Usage</td>
<td>State the proper type of overcurrent protection for given circuit.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art. 240-8, 50, 51, 52, 53, 54, 60, 61, C.</td>
</tr>
</tbody>
</table>
LEVEL II ELECTRICAL PRINCIPLES AND PRACTICES

Unit: 10 WIRING METHODS

Major Objective: Apply wiring methods recognized by the code

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Raceways</td>
<td>State two types of raceways</td>
<td>Lecture/display</td>
</tr>
<tr>
<td></td>
<td>Name the type most commonly used in residential wiring.</td>
<td>Ref./Text p. 320-323</td>
</tr>
<tr>
<td></td>
<td>State the minimum trade size of PVC</td>
<td>Stress: metallic and</td>
</tr>
<tr>
<td></td>
<td>State the number of bends allowed in each run of raceway. (Maximum)</td>
<td>non-metallic</td>
</tr>
<tr>
<td></td>
<td>Connect or join PVC</td>
<td>Lecture</td>
</tr>
<tr>
<td></td>
<td>Bend PVC by using heat</td>
<td>Non-metallic (PVC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lecture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art 347-10 (4&quot;)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lecture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art 347-13 (4 ½ bends)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text p.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lecture/Demonstration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text p.</td>
</tr>
<tr>
<td>SUB-UNITS</td>
<td>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</td>
<td>SUGGESTED LEARNING ACTIVITIES</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>A. Raceway</td>
<td>Name the fittings used with PVC</td>
<td>Lecture/display</td>
</tr>
<tr>
<td></td>
<td>Name other materials used with PVC</td>
<td>Stress: adapters, couplings</td>
</tr>
<tr>
<td></td>
<td>Use the NEC to determine size of raceway and number of conductors that can be inserted into the raceway</td>
<td>Lecture/display</td>
</tr>
<tr>
<td></td>
<td>Name other types of raceways</td>
<td>Stress: straps, locknuts, bushing, condulets, boxes, and covers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lecture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art 347-11, Table 1 Chapter 9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lecture Ref./Text p.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Chapter 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rigid conduit, EMT, flexible conduit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lecture/Display</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text p. 76-87</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lecture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art 336</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Have student install wiring using NM cable</td>
</tr>
<tr>
<td>b. Cables</td>
<td>Define the term &quot;cable&quot;</td>
<td>Lecture</td>
</tr>
<tr>
<td></td>
<td>Using the NEC state the article which covers NM cable.</td>
<td>NEC (Use not permitted and permitted)</td>
</tr>
<tr>
<td></td>
<td>Demonstrate ability to install wiring using NM cable.</td>
<td>Lecture</td>
</tr>
<tr>
<td></td>
<td>Use the NEC to select the correct wiring methods for either a concrete block dwelling or wooden structure.</td>
<td>Lecture/demonstration</td>
</tr>
</tbody>
</table>

**Suggested Learning Activities**

- Lecture/display
- Stress: adapters, couplings
- Lecture/display
- Stress: straps, locknuts, bushing, condulets, boxes, and covers
- Lecture
- NEC Art 347-11, Table 1 Chapter 9
- Lecture Ref./Text p.
- NEC Chapter 3
- Rigid conduit, EMT, flexible conduit
- Lecture/Display
- NEC 100
- Ref./Text p. 76-87
- Lecture
- NEC Art 336
- Lecture/demonstration
- Have student install wiring using NM cable
- Lecture
- NEC (Use not permitted and permitted)
### Major Objective:

DETERMINE THE Proper size conductor for grounding an electrical system.

Determine the proper size conductor for grounding equipment.

### SUB-UNITS

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Purpose</td>
<td>Explain why electrical systems and equipment are grounded.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art. 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text p. 295</td>
</tr>
<tr>
<td>b. Types of grounding</td>
<td>State the different types of grounding utilized in residential wiring.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art 250 - 5, E-42, 43, 44, 45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text p. 295-299</td>
</tr>
<tr>
<td>c. Methods of grounding</td>
<td>Discuss and explain two different methods of grounding.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art 250-F</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Text p. 299-305</td>
</tr>
<tr>
<td>d. Bonding</td>
<td>Explain the purpose of bonding and draw a diagram of bonding a distribution panel and service.</td>
<td>Lecture/diagram/discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art 250-53b, 250-G</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text p. 305-312</td>
</tr>
<tr>
<td>SUB-UNITS</td>
<td>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</td>
<td>SUGGESTED LEARNING ACTIVITIES</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td>e. Selecting grounding and bonding conductors</td>
<td>Select the proper size conductor for grounding and bonding a residential service system using the NEC.</td>
<td>Lecture/explanation</td>
</tr>
<tr>
<td>f. NEC requirements</td>
<td>Utilize the NEC to determine when and how to ground and bond services and equipment.</td>
<td>Ref./Text p.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art. 250</td>
</tr>
</tbody>
</table>
LEVEL II ELECTRICAL PRINCIPLES AND PRACTICES

Unit: 12 ELECTRICAL SERVICE SYSTEM

Major Objective: Determine and select the proper materials for a service entrance.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Types of services</td>
<td>Name two types of residential services.</td>
<td>Lecture/discussion/diagram Single phase, two wire Single phase, three wire Voltage: 115/230 or 120/240 Ref./Text p. 255, 279</td>
</tr>
<tr>
<td>b. Parts of the service</td>
<td>List the parts of an electrical service entrance.</td>
<td>Lecture/transparency Service entrance cap/head Service mast (pipe) Meter base (socket) Ref./Text p. 256-266</td>
</tr>
<tr>
<td>c. Calculating service</td>
<td>Determine or compute the required rating of a service entrance.</td>
<td>Lecture/illustration NEC Art. 230-41b (1), (2) Chapter 9 example #1</td>
</tr>
<tr>
<td>SUB-UNITS</td>
<td>PERFORMANCE OBJECTIVES</td>
<td>SUGGESTED LEARNING ACTIVITIES</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>d. Selecting service entrance materials</td>
<td>State the materials used for service entrances.</td>
<td>Lecture/display</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Entrance head/cap</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conduit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Connectors and fittings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Meter base</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Condulets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conduit straps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Insulator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conductors</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text p. 263, 274, -2:7</td>
</tr>
<tr>
<td>e. Installing services</td>
<td>Assemble materials and install a service entrance.</td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text p.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TM ____ / HO 3</td>
</tr>
<tr>
<td>f. NEC requirement</td>
<td>Complete an exam on services with 80% correct.</td>
<td>Lecture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art. 230</td>
</tr>
</tbody>
</table>
## Major Objective:
Analyze basic wiring problems in lighting circuits and correct them.

### SUB-UNITS

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Analyze electrical diagrams</td>
<td>Read and interpret schematic and wiring diagrams and trace current flow.</td>
<td>Lecture/diagram schematic and wiring diagram Ref./Text p.</td>
</tr>
<tr>
<td>b. Determine malfunction</td>
<td>Select the proper meter or tester to identify malfunction or disorder.</td>
<td>Lecture/review test instruments. Ref./Text p. Build/wire defective circuit</td>
</tr>
<tr>
<td>d. Retest</td>
<td>State the procedure for safely retesting a defective circuit.</td>
<td>Lecture/demonstration List procedure Ref./Text p.</td>
</tr>
</tbody>
</table>
A. COURSE TITLE: ELECTRICAL APPLICATIONS AND INSTALLATIONS

B. COURSE DESCRIPTION

This final course covers the planning and designing of electrical circuits which are applied to residential dwellings. Some job acquisition skills are also taught to prepare students for employment.

Raceway wiring practices and techniques as well as testing, and analyzing electrical circuits are stressed in shop practice.

C. GOALS

The goal of this course is to prepare the student for entry level employment in the residential wiring industry. Safety practices as well as occupational skills, attitudes, and future employment trends are stressed.

D. COURSE OBJECTIVES

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

1. Practice safety procedures used in industry
2. Plan and layout electrical circuits for a residential dwelling
3. Examine and explain the use of various electrical systems
4. Apply the requirements of the NEC to residential wiring
5. Select and install wiring devices and materials
6. Prescribe the type of fixture for specific locations and their classification
7. Analyze an existing lighting circuit and recommend procedures to alter the lighting control
8. Explain the purpose of acquiring good job acquisition skills
9. Select a project to develop awareness in other electrical occupations
10. Acquire up-to-date information on subjects that are related to the job market and future trends.

E. COURSE OUTLINE

1. Safety
   a. Accident prevention

119
2. Planning and Laying Out Electrical Circuits
   a. Blueprint reading
   b. Interpreting electrical specifications
   c. Interpreting electrical symbols
   d. Single-family dwelling calculations
   e. Wiring methods
   f. Code requirements

3. Electrical System Analysis
   a. Types of systems
   b. Applications
   c. Schematic diagrams

4. Advanced Interpretation of the National Electrical Code
   a. Use of tables and examples
   b. Wiring methods and materials
   c. Equipment for general use
   d. References and guides

5. Wiring a Residential Unit/Dwelling
   a. Locating lighting outlets
   b. Locating receptacle outlets
   c. Locating appliance outlets
   d. Locating switch outlets
   e. Rough-in wiring (installing raceways and conductors)
   f. Installing devices and cover plates
   g. Installing services
   h. Installing panelboards and circuit breakers
   i. Installing lighting fixture
   j. Testing and evaluating wiring

6. Lighting Fixtures
   a. Types of fixtures
   b. Selection and application
   c. Types and ratings of light bulbs/lamps
   d. Automatic controls
   e. Installing fixtures
   f. Code requirements
7. Renovation and Troubleshooting
   a. Differentiate between alteration, repair, and new work
   b. Selecting proper materials
   c. Rearranging lighting controls
   d. Code requirement
   e. Terms and definitions

8. Job Acquisition Skills
   a. Job application process
   b. Developing a resume
   c. Future educational goals/Postsecondary education

9. Advanced Electrical Wiring
   a. Repairing small appliances
   b. Repairing large appliances
   c. Troubleshooting procedures
   d. Individual projects

10. Guest Speakers
    a. Government
    b. Industry
    c. Business
    d. Others

11. Field Trips
    a. 
    b. 
    c. 

F. METHOD OF EVALUATION
   1. Written Examination
   2. Oral
   3. Attendance
   4. Performance
   5. Classroom Participation

G. TEXT AND REFERENCES
   1. 
   2. 
   3. 

121
H. CLASSROOM EQUIPMENT

1. Overhead Projector
2. 16 mm Projector
3. Colored chalk
LEVEL III ELECTRICAL APPLICATIONS AND INSTALLATIONS

Unit: 1 SAFETY

Major Objective: Practice safety procedures used in industry

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Accident prevention</td>
<td>Identify unsafe/hazardous equipment and prescribe corrective measure.</td>
<td>Lecture/demonstration Visual aid (if available)</td>
</tr>
<tr>
<td>b. Equipment grounding</td>
<td>Discuss the importance of grounding equipment and methods used to ground equipment.</td>
<td>Lecture/demonstration Ref./Text page 296-299</td>
</tr>
<tr>
<td>c. Safety rules</td>
<td>List as many safety rules which will prevent accidents.</td>
<td>Lecture/handout Ref./Text p. Ref. /Text p. TM</td>
</tr>
</tbody>
</table>
LEVEL III ELECTRICAL APPLICATIONS AND INSTALLATIONS  
Unit: 2 PLANNING AND LAYING OUT ELECTRICAL CIRCUITS

Major Objective: Plan and layout electrical circuits for a residential dwelling

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Blueprint reading</td>
<td>Able to discuss the importance of blueprint reading for electricians.</td>
<td>Lecture/discussion Ref./Text. p. 25</td>
</tr>
<tr>
<td>b. Interpreting electrical</td>
<td>State the reasons for having a set of specification.</td>
<td>Lecture/discussion Ref./Text. p. 63</td>
</tr>
<tr>
<td>specification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Interpreting electrical</td>
<td>Discuss and identify the electrical symbols used in blueprints.</td>
<td>Lecture/discussion Ref./Text. p. 26</td>
</tr>
<tr>
<td>symbols</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| d. Single-family dwelling        | Estimate the number of circuits required for a dwelling and layout the   | Lecture/discussion Ref./Text. p. 38
|                                  |   required number of outlets.                                            | NEC Chapter 9 Example 1
|                                  |                                                                          | Floor plan HD 11                              |
| e. Wiring methods                | Select wiring methods for both concrete and wooden structures.          | Lecture/discussion NEC art. 336, 347, 346, 348, 339                                          |
| f. Code requirements             | State the code articles that pertains to electrical circuits and layout. | Lecture/discussion NEC Art. 210, 220.                                                         |
LEVEL III ELECTRICAL APPLICATIONS AND INSTALLATIONS
Unit: 3 ELECTRICAL SYSTEM ANALYSIS

Major Objective: Examine and explain the use of various electrical systems.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Types of systems</td>
<td>Explain the difference between a single-phase and three-phase electrical system.</td>
<td>Lecture and diagram/Ref./Text. p. Load requirement</td>
</tr>
<tr>
<td>b. Applications</td>
<td>State when and where single-phase and three-phase systems are utilized.</td>
<td>Lecture/discussion/Ref./Text. p. Residential/Commercial, Industrial</td>
</tr>
</tbody>
</table>
### Major Objective:
Apply the requirements of the NEC to residential wiring

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Use of tables</td>
<td>Select the tables for sizing grounding conductors, conduit fill, conductor fill for boxes.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Tables 250-94, 250-95, 3A Chapter 9, 370-6(a)</td>
</tr>
<tr>
<td>b. Wiring methods and materials</td>
<td>List the wiring methods approved for residential wiring and the basic materials Name the code articles that covers the materials listed above.</td>
<td>Lecture/discussion review methods and materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art. 279, 380, 384, 410</td>
</tr>
<tr>
<td>c. Equipment for general use.</td>
<td>List those articles which pertains to residential wiring.</td>
<td>NEC Chapter 4</td>
</tr>
<tr>
<td>d. References and guides</td>
<td>List at least two references and guides that would aid an electrician to interpret the NEC.</td>
<td>Read and discuss</td>
</tr>
</tbody>
</table>
## Major Objective:
Select and install wiring devices and materials.

### SUB-UNITS

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Locating lighting outlets</td>
<td>Identify various types of lighting outlets and locate outlet on framed structure.</td>
<td>Review symbols/Demonstration Read blueprint Use tape rule, climb ladder</td>
</tr>
<tr>
<td>b. Locating receptacle</td>
<td>Identify receptacle symbols and locate outlet on framed structure.</td>
<td>Review symbols/demonstration read blueprint use tape rule</td>
</tr>
<tr>
<td>c. Locating appliance outlets</td>
<td>Identify appliance outlets and locate on framed structure.</td>
<td>Review symbols/demonstration read blueprint, use tape rule.</td>
</tr>
<tr>
<td>d. Locate switch outlets</td>
<td>Identify switch symbols and locate outlet on framed structure.</td>
<td>Review symbols/demonstration read blueprint, use tape rule.</td>
</tr>
<tr>
<td>e. Rough-in wiring</td>
<td>Select proper size PVC and install to outlet boxes</td>
<td>Lecture/demonstration Use of hack saw, glue, adapters, raise covers. Ref. Text. p. 83,94</td>
</tr>
<tr>
<td>SUB-UNITS</td>
<td>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</td>
<td>SUGGESTED LEARNING ACTIVITIES</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>e. Rough-in wiring</td>
<td>Determine conductor fill for boxes and conduits.</td>
<td>Lecture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Chapter 9 Table 3A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Art. 370 Table 370 6(a)</td>
</tr>
<tr>
<td>f. Installing devices and cover plates</td>
<td>Select proper devices and cover plates and install same.</td>
<td>Lecture/demonstration/demonstration/display</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text. p. 26–28</td>
</tr>
<tr>
<td>g. Installing services</td>
<td>Describe procedure in installing services.</td>
<td>NEC. Art. 370–15</td>
</tr>
<tr>
<td></td>
<td>List the materials used in a mast type service.</td>
<td>Lecture/Demonstration</td>
</tr>
<tr>
<td></td>
<td>Mount a panelboard and install circuit breakers.</td>
<td>Ref./Text. p. 255–294</td>
</tr>
<tr>
<td>h. Installing panelboard and circuit breakers.</td>
<td>Install fixtures used in dwellings</td>
<td>Stress bonding and grounding</td>
</tr>
<tr>
<td>i. Installing lighting fixtures.</td>
<td>Test wiring which are free from shorts or grounds and passes an inspection by the instructor.</td>
<td>NEC Art. 230–2, 22, 24, 26,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>41, 46, 71, 79(c)</td>
</tr>
<tr>
<td>j. Testing and evaluating</td>
<td></td>
<td>Lecture/display</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text. p. 262, 263</td>
</tr>
<tr>
<td></td>
<td>All installations to be done in shop.</td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text. p. 272–279</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC. Art. 384–7, 15, 16, 27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text. p. 405–407</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEC Art. 410–8, 12, 13, 15,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16, 17, 23, 26, 27, 28, 30, 31</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lecture/demonstration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ref./Text. p. 405–407</td>
</tr>
</tbody>
</table>

75
**LEVEL III ELECTRICAL APPLICATIONS AND INSTALLATIONS**

*Unit: 6 LIGHTING FIXTURES*

**Major Objective:** Prescribe the type of fixtures for specific locations and their classification

<table>
<thead>
<tr>
<th><strong>SUB-UNITS</strong></th>
<th><strong>PERFORMANCE OBJECTIVES</strong></th>
<th><strong>SUGGESTED LEARNING ACTIVITIES</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Types of fixtures</td>
<td>List five different types of fixtures</td>
<td>Lecture/display recess, surface mounted, vapor proof, weather proof, incandescent, fluorescent, mercury vapor.</td>
</tr>
<tr>
<td>b. Selection and application</td>
<td>State the procedure to use in selecting fixtures for specific location and applications.</td>
<td>Lecture/discussion Ref./Text. p. 425 NEC. Art. 410-4</td>
</tr>
<tr>
<td>c. Types and ratings of light bulbs</td>
<td>List the types and manner in which light bulbs are rated.</td>
<td>Lecture/display Ref./Text. p. 129-132</td>
</tr>
<tr>
<td>d. Automatic controls</td>
<td>List two types of automatic control devices used for lighting.</td>
<td>Lecture/display photo-cell time switch</td>
</tr>
</tbody>
</table>

Text: Electrical Construction
Ref.: NEC
House Wiring Simplified
<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>e. Installing fixtures</td>
<td>Install and hook-up fixtures to lighting outlets.</td>
<td>Lecture/demonstration ref./text. p. 87</td>
</tr>
<tr>
<td>d. Code requirement</td>
<td>State the code requirement for installing fluorescent fixtures, closet fixtures, and recess fixtures.</td>
<td>Lecture/demonstration nec art. 410-31 410-8 410-66</td>
</tr>
</tbody>
</table>
Major Objective: Analyze an existing lighting circuit and recommend procedures to alter the lighting control.

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
</table>
| a. Differentiate between alteration, repair, and new work. | Define terms used in alteration/renovation in electrical wiring.  
Discuss the difference between alteration, repair, and new work. | Lecture/demonstration  
Ref./Text. p. 405-437                                               |
| b. Selecting proper materials      | Select and identify by trade name materials used in electrical wiring. | Lecture/discussion  
Ref./Text p. 408-434                                               |
| c. Rearranging lighting controls   | Analyze a single pole switching circuit and recommend procedure in changing the switching arrangement to control the light from two locations. | Lecture/diagram  
Stress wiring diagrams and schematic diagrams, conductor fill. |
| d. Code requirement                | Identify code articles that would be used in the above objectives.                                                      | Lecture/discussion  
NEC Table 370-6(a),  
Chapter 9 Table 3A  
Lecture/discussion                                                       |
| e. Terms and definitions           | Define terms and definitions used in renovation wiring.                                                                  |                                                                     |
### Major Objective:
Explain the purpose of acquiring good job acquisition skills

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Job application process</td>
<td>Fill out samples job application forms</td>
<td>Lecture/explanation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Application form: Civil Service,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Telecommunications Corp.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Saipan Cable T.V. Co.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Saipan Continental</td>
</tr>
<tr>
<td>b. Developing a resume</td>
<td>Complete a resume</td>
<td>Lecture/explanation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Handout sample resume #17</td>
</tr>
<tr>
<td>c. Future educational goals/postsecondary education</td>
<td>Make a rational choice whether to continue their education and name a few schools that would provide the type of education to satisfy their needs.</td>
<td>Lecture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Guest speaker</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MOC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UOG</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HAWCC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HONCC</td>
</tr>
</tbody>
</table>
Major Objective: Select a project to develop awareness in other electrical occupations

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Repairing small appliances</td>
<td>Describe what a small appliance repair-person does. Select the proper test instrument to be used in repairing small appliances.</td>
<td>Assignment by instructor Ref. DOT</td>
</tr>
<tr>
<td>b. Repairing Major appliances</td>
<td>Describe what a major appliance repair-person does. List by names appliances which are considered as being major appliances.</td>
<td>Assignment by instructor Ref. DOT</td>
</tr>
</tbody>
</table>
### LEVEL III  UNIT 9  ADVANCED ELECTRICAL WIRING

<table>
<thead>
<tr>
<th>SUB-UNITS</th>
<th>PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)</th>
<th>SUGGESTED LEARNING ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. Troubleshooting procedures</td>
<td>Describe and read troubleshooting procedures.</td>
<td>Lecture/discussion</td>
</tr>
<tr>
<td></td>
<td>Apply procedures in repairing a major appliance.</td>
<td>Ref. Home Appliance Guide-p. 68-91</td>
</tr>
<tr>
<td>d. Individual projects</td>
<td>Select an activity in appliance repair.</td>
<td>Project assigned by instructor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Student/instructor agreement.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stress: Work habits, safety, responsibility, neatness.</td>
</tr>
</tbody>
</table>
APPENDICES
APPENDIX A JOB DESCRIPTION
JOB DESCRIPTION:

RESIDENTIAL ELECTRICIAN

The residential electrician performs repairs and maintains existing wiring in a residential structure. The electrician is responsible for the layout of new residential wiring, the calculation and installation of branch circuits, and other basic circuits. The electrician also installs proper size service entrance, installs electric heating and cooling if required, and installs all electrical devices used in a residence. This work is performed in a neat and workman-like manner to conform to local and National Electrical Code requirements.

In the process of performing these tasks, the electrician uses a basic set of handtools which are held in a tool pouch, hand held electric drills, an assortment of drill bits, extension cords, test instruments, ladders, hack saws, keyhole saw, fastening devices, etc.

The electrician works in cramped places, under buildings, on scaffoldings and ladders, both indoors and outdoors.
RESIDENTIAL WIRING TASKS

1. Read and interpret electrical plans and specifications
2. Layout general purpose receptacle outlets
3. Layout switch outlets
4. Layout lighting outlets (wall brackets)
5. Layout appliance outlets
6. Layout signal circuit outlets (low voltage)
7. Layout panelboard location
8. Layout route for raceways and cables
9. Install raceways and fittings
10. Install and set receptacle boxes.
11. Select, install, and set switch boxes
12. Select, install, and set appliance boxes
13. Select and install panelboard
14. Layout ceiling lighting outlets
15. Install raceways to lighting outlets and switch points
16. Select, and install raceways for branch circuits
17. Layout service equipment and feeder
18. Select and install raceways for service and feeder
19. Select proper size wire and pull wires for outlets and branch circuits
20. Select proper size wire and pull wires for service and feeder
21. Splice and terminate all conductors
22. Select and install switches and receptacles
23. Install circuit breakers in panelboard and tie-in branch circuits
24. Select and install fixtures
25. Select and install cover plates
26. Select and install system ground conductor
27. Install push button and chimes (signal equipment)
28. Install panelboard cover
29. Test all circuits and balance load in panelboard
30. Label circuits in panelboard
31. Call for or apply for service drop and meter

Note: All wiring to be coordinated with other building trades occupations.

All wiring is approved by the power company before service is energized.
APPENDIX C SAMPLE LESSON PLAN
LESSON PLAN

LEVEL I INTRODUCTION TO ELECTRICITY

UNIT 2 SHOP ORIENTATION

Instructor Plan

Student Objectives:

a. Discuss various aspects of rules and regulations of the shop and classroom.

b. Assess what is to be learned in the program of study.

c. Determine methods used in grading.

d. Make maximum use of learning resources.

e. Identify areas that are used as aisles, work-stations, construction areas, tools and material storage.

f. Identify area designated as tool room and state procedure in acquiring tools for shop use.

1. Shop Policy:

   Shop rules
   Starting and ending hours/time
   Smoking prohibited in shop
   Absence
   Tardy
   Illness
   Personal hygiene
   Cooperation
   Student conduct
   Advising and counseling

2. Introduction of Course Content:

   Discuss course content
   Course objectives
   Text and references
   Courses for further studies

3. Grading Policy:

   Written examination
   Classroom participation
   Attendance
   Assignments/homework
   Shop practice/lab.
4. Location of Books and References:
   Classroom
   Library
   Borrowing policy

5. Shop Layout:
   Tour of shop
   Tool room
   Toilet
   Drinking fountain
   Work bences
   Construction wiring area
   Shop exits

6. Location of Tools:
   Handtools located in tool room
   Tool check out policy
   Student responsibility
LESSON PLAN

LEVEL I  INTRODUCTION TO ELECTRICITY

UNIT 3  SAFETY

Instructor Plan

Student Objectives:

a. Pass an examination on safety with 100% accuracy.
b. List the emergency first aid procedure.
c. Explain how improper ventilation and lighting can be hazardous to work condition.
d. Develop proper lifting skills and procedures for handling chemicals.
e. Identify the location of the nearest fire extinguisher and state type of fire it can be used on.

Introduction:

Safety should be a concern of everyone. Your interest in safety includes that of protecting yourself and others from injury. Much emphasis is given to safety in all sectors of society. "Accidents don't just happen; they are caused". In times past, people frequently considered accidents as inevitable or "acts of God". Today this concept is no longer acceptable as a way of explaining accidents. A safety minded person has a perception of existing hazards. Preparation must be made for protection and to prevent accidents precautions must be taken.

1. Safety Program

   1.1 Attend seminar on Safety Program
   1.2 Guest speaker on safety
   1.3 Have students observe posters in classroom and shop and have discussion on these posters

2. First aid

   2.1 Emergency first aid procedure

      a. Call doctor or ambulance 
      b. Inform instructor of accidents. Large or small

   2.2 Demonstration by fire department (First aid)
3 Ventilation and Lighting

3.1 Ventilation

a. Open windows and doors before working
b. Turn on fans if available
c. Close all windows, louvers, and doors when work has ended
d. Turn off fans if applicable

3.2 Lighting

a. Turn on all lights when beginning class/shop work
b. Inform instructor if lights are not operable
c. Provide for portable lighting when more lights are desirable
d. Be sure that lights on electrical tools are in good working condition

4. Material Handling and Storage

4.1 Avoid injury by not lifting too heavy an object
   Push, pull, roll, or slide when possible
   If object is over 25 pounds, get assistance
   Develop proper lifting skills
   Always wear shoes
   If more than one persons is lifting the object, work as a team
   Demonstrate carrying.....pack a box with about 25 lbs. of books
   Check your footing. Avoid slippery or hazardous areas
   Spread your feet slightly (comfortable) with one foot slightly forward and along side of object.
   Bend knees, kneel or squat
   Do not bend back to reach for load
   Get close to object being carried
   Use blocking under objects to provide hand space...demonstrate
   Get a firm grip..use gloves when handling sharp objects..demonstrate
   Let your legs do the lifting....demonstrate
   Shift the feet to turn...demonstrate

   To lower load, bend the knees, keep the back straight, and use legs and arms to lower the load
   When moving long objects, check that the area is clear of obstructions, persons, and co-workers
   Film, if available

4.2 Chemicals
   Check with instructor before using any chemicals or solvents
   Avoid contact to skin
   Wear rubber gloves or plastic gloves
   Use face shield
   Do not inhale fumes
5. Location of Fire Extinguishers

4.1 Identify location of nearest fire extinguisher. Identify or state type of fire that this fire extinguisher can be used for. Do not play with fire extinguishers. Always return them at their intended location. Report to instructor if fire extinguisher is not at the proper location.

4.2 Types of Fire Extinguishers
Provide students with handouts #11
Type ABC dry chemical the most commonly used.

4.3 Have students state types of fires and type of extinguisher to be utilized. Use handouts.
LEVEL I INTRODUCTION TO ELECTRICITY

UNIT 3 SAFETY

TEST

In the space provided at the end of each statement, write a T if the statement is True and F if the statement is False.

1. When someone in the shop has an accident, you should notify your principle first. ___

2. Portable first aid kits are provided to apply simple aid to minor cuts or burns. ___

3. The purpose of the exhaust fans are to circulate the air in the shop. ___

4. When using stationary power tools in the shop such as a drill-press or grinder, it is not desirable to have lighting at each tool. ___

5. In carrying and lifting long objects such as conduits or wood consider that no one is around. ___

6. To avoid electrical shock, all ornaments such as rings, watches, chains, and other metal objects should be removed before attempting to work on live circuits. ___

SHORT ESSAYS:

7. List the three-step emergency first aid procedure.

8. List at least five proper procedures in lifting heavy objects.

9. Name three classes of fires and indicate what causes these fires.
LESSON PLAN

LEVEL I INTRODUCTION TO ELECTRICITY

UNIT 4 USE AND CARE OF ELECTRICAL WIRING TOOLS

Instructor Plan

Student Objectives:

a. Demonstrate the proper use and care of screw drivers.
b. Demonstrate the proper use and care of phillips screw drivers.
c. Demonstrate the proper use and care of knives.
d. Demonstrate the proper use and care of the diagonal pliers.
e. Demonstrate the proper use and care of the long nose pliers.
f. Demonstrate the proper use and care of the lineman's plier.

Introduction:

Importance of use and care of electrical wiring tools.

1. When properly applied, they are time savers.
2. When properly cared for, they are safe to use and prevents accidents.
3. Overall appearance of the job will look acceptable. (Workmanship)
4. Mark of a qualified tradesperson.

a. Screwdriver: Display
   Use to install various types of straight slot screws.
   Sized according to length of shank and width of tip.
   example: OH (overhead transparency)
   Insulated handles to prevent electrical shock
   Keep handles free of burrs.
   Tip should be as wide as the slot of the screw.
   Keep tips ground straight and flat (OH)/demonstrate
   When installing screws, keep screwdriver level or plumb to prevent slippage. Demonstrate.

b. Phillips screwdriver: Display
   Used to install various sizes of phillips screws.
   Tip has a tee slot and thus provide more grip and prevents slippage.
   Sized according to length of shank and width of tip.
   example: OH.
   Keep handles free of burrs.
   Blades should be kept straight.
   When installing screws, keep screwdriver level and plumb to prevent slippage. Demonstrate.
c. Knife: Display
   Used to skin or remove insulation from conductors and cables. Whenever possible, face blade away from body. Demonstrate. Keep blade sharp to prevent accident as well as achieving maximum advantage.

d. Diagonal pliers: Display.
   Used for cutting conductors, cables, stripping insulation, and form loops. Demonstrate. Keep handles free from oil and grease to prevent slippage. Insulated handle will prevent electrical shock. Not to be used as a hammer.

e. Longnose pliers: Display.
   Used to reach into narrow/tight spaces, form loops, making splices. Demonstrate. Do not use longnose to tighten large bolts or nuts. Use insulated handles whenever possible.

f. Side cutting pliers/lineman's pliers: Display.
   Used for cutting conductors, cables, and stripping insulation off conductors. Also used to form loops for terminal connections and splicing. Demonstrate. Keep handles free from oil and grease to prevent slippage.

g. Channel lok pliers: Display.
   Used to tighten and remove locknuts and bushings, to install split-bolt connectors, gripping conduits and tubings. Demonstrate. Adjust opening according to width of work and be able to hold handle with one hand if possible. Demonstrate. Tighten and loosen objects so that the direction you are turning will provide the greatest grip. Demonstrate.

h. Torpedo level: Display.
   Used to level and plumb work. Demonstrate. Magnetic base will provide a free hand when using a level. Do not drop level or damage surface.

i. Tape rule: Display.
   Used for measuring distances. Do not leave tape rule opened and laying out. Recommend 12 feet ruler or longer. Conduits are 10 feet long and you may over extend the rule. Comes in different types of materials and color. Avoid kinking tape to prevent breakage.
j. Chisels: Display.
   Used for notching wood
   Keep chisels sharp and handles free of burrs and grease.
   Sized according to the width of the cutting blade. Demonstrate.

k. Hammer: Display.
   Electrician's or ripping hammer. Claw is less curved than
   the carpenter's hammer.
   Sized according to weight.
   Keep hammer head smooth and free of burrs or mushrooming.

l. Keyhole saw: Display.
   Used for cutting opening for boxes, notching.
   Classified according to type of blade. May be used to cut
   wood, metal, gypsum board, and fiber boards.
   Start cut by pulling back towards you. This may prevent the
   blade from jumping and cutting your hands or fingers.

m. Wire stripper: Display.
   Used to strip insulation off conductors and form terminal
   loops.
   Also used to cut smaller sizes of conductors. Demonstration.

n. Hacksaw: Display.
   Used for cutting conduits, cables, metals, woods, and fiber-
   boards.
   Blades classified according to the number of teeth/tooth per
   inch., recommend using 18 or 24 teeth blade for electrical
   work.
   When cutting, keep hacksaw frame straight. Demonstrate.
   Pull back when starting any cuts before making forward
   strokes to prevent saw from jumping and cutting your hands
   or fingers.

o. Vise grip pliers: Display
   Used as a locking pliers to provide a strong grip and
   prevent slippage.
   Take precaution not to damage area where pliers grip.
   Keep handles clean and jaws free of debris to prevent
   slippage.

p. Tool pouch: Display.
   Used for carrying hand tools.
   Made of leather and should be kept from drying out and cracking
   Use a leather preservative or saddle soap.
   Keep tool points facing in the pouch when carrying tools
   rather than the points up.
Identify at least 14 of the 16 tools which will be shown to you and state its use.

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 
9. 
10. 
11. 
12. 
13. 
14. 
15. 
16. 
APPENDIX C

LESSON PLAN

LEVEL I  INTRODUCTION TO ELECTRICITY

UNIT 5  SOURCES OF ELECTRICITY

INSTRUCTOR PLAN

Student Objectives:

a. Explain how electricity can be produced by friction.
b. Explain how electricity can be produced by chemical.
c. Explain how electricity can be produced by magnetism.
d. Explain how electricity can be produced by pressures.
e. Explain or give an example of a form of electricity that is produced by light.

a. Friction:

A form of static electric. Can be produced by rubbing two objects together.

Procedure in setting-up an experiment:

1. One piece of silk rag 12" x 12"
2. A glass rod about 12" long
3. Fold silk cloth in half and place rod between silk. Some electrons are transferred from the cloth to the rod, the rod is no longer neutral because it now has more negative electrons than positive protons.
4. Pick-up small bits of paper with the glass rod.

b. Chemical:

The simplest kind of cell consists of two pieces of different metals in a solution.

The pieces of metals are called electrodes. These electrodes must be of different metals. The solution is called an electrolyte. The electrolyte must be a conductor of electric current. It must have a chemical action with one of the electrodes.

Another type of battery is called the storage battery or secondary cell.

Procedure in setting-up an experiment:

1. A glass jar
2. A copper bar and a zinc bar
3. Sulfuric acid and water. NOTE: MIX ACID INTO WATER TO PREVENT RAPID CHEMICAL ACTION... (H2SO4)
4. Use galvanometer to test voltage.

**c. Magnetic:**
The simplest form of magnetic/mechanical means of producing EMF is by **winding** a magnet into a coil of wire. THE GENERATOR

Procedure in setting-up an experiment:

1. a bar magnet
2. Ten feet of copper conductor, #16 or smaller formed into a loop wide enough to move the bar magnet into. Skin both ends of the loop.
3. Connect ends of loop to galvanometer or sensitive volt meter.
4. Slide magnet into loop and note needle deflection on meter.
5. You have now produced EMF by using a magnet.

**d. Pressure:**
Electricity is produced when pressure is applied to a crystal. Substance such as quartz, tourmaline, and Rochelle salts are good examples of electrical charges.

1. A piece of crystal
2. A metal plate
3. Insert the crystal between the metal plate and move the crystal back and forth. Note results
4. Connect leads to galvanometer.

**e. Light:**
The simplest form is a photo cell which utilizes selenium to produce EMF which in turn energizes a contact to open and close the circuit of the photo cell to control lites or other apparatus.

Procedure in setting-up an experiment:

1. Selenium, iron and translucent window.
2. Insert the selenium in between the iron and translucent window.
3. Apply light through the translucent window.
4. Connect galvanometer to leads and note reaction.
f. Heat:

The simplest form is a thermocouple. Connecting two different types of metals and applying heat to the joint will produce EMF.

Procedure in setting-up an experiment:

1. A piece of copper wire
2. A piece of zinc
3. Candle/Flame
4. Combine both the copper and zinc and connect ends to a galvonometer.
5. Heat the joint with the candle and note meter movement.

TM 29
Note: After the glass rod and silk are rubbed together, they become charged with electricity.

Another method of producing friction:
Piece of wood (soft type, work faster)
One 12 inches long wood (diameter 1/4 of inch)
Diagram showing a chemical reaction:

1. Positive Hydrogen ions
2. Negative Sulfate ions
3. Sulfuric Acid & Water
4. Copper (gives up electrons)
5. Zinc (gives up positive ions)
Crystal

metal plate

No voltage developed

Pressure

Electricity from pressure

voltage
Electricity from heat
Voltage developed here

Translucent Window

Selenium

Iron

Electricity from light
Level I INTRODUCTION TO ELECTRICITY

UNIT 5 SOURCES OF ELECTRICITY

TEST

List five sources of electricity and state how electricity is produced by each source.

1.

2.

3.

4.

5.

The following questions are True and False items, place a T or F to make each statement correct.

6. ____ Electrolyte is formed when sulphuric acid and water is mixed.

7. ____ The formula for sulphuric acid and water is H2SO4.

8. ____ Magnet can be created by placing a metal into an energized coil of wire.

9. ____ When two unlike poles are placed close together, they repel each other.

10. ____ Electricity is produced when pressure is applied to a crystal

11. ____ Batteries are examples of static electricity
LEVEL I  INTRODUCTION TO ELECTRICITY

UNTI 6  Electrical Distribution

Instructor Plan

Student Objectives:

a. State the purpose and location of the nearest power plant in your area.

b. Identify the transmission lines when shown a distribution system lines.

c. Identify and differentiate between the distribution lines and transmission lines.

d. Identify the service conductors on a drawing or an actual installation.

e. Distinguish between feeder lines and service lines, and state the function.

a. The power plant

1. Located in Lower Base, Tanapag
   Purpose: To generate enough power to provide the electrical needs of the island.
   TM 1 Note: Voltage output from the generator ___ volts.

b. Transmission Line

1. The power lines that leave the generating plant...usually the highest rated voltage line in the system.
   Note: step-up Substation on TM
   TM 1

c. Distribution Lines

1. Distribution lines are mounted at a lower height than the transmission lines and are of a lower voltage rating than the transmission lines.
   TM1: Note: Step-down Substation before distribution lines.
d. Services
1. Those are the conductors from the last pole to the premises being serviced. Either overhead or underground.
2. Have students state whether their service is underground or overhead.

e. Feeder Lines
1. Feeder lines or conductors are those lines from the service equipment to the panelboard.
2. Residential wiring usually employ four (4) conductors.
   - 2 hot conductors
   - 1 neutral conductor
   - 1 equipment grounding conductor
3. Diagram of feeder conductors:

   ![Diagram of feeder conductors]

f. Arrange for field trip to the power plant

g. Administer exam.
LEVEL I  INTRODUCTION TO ELECTRICITY

UNIT 6  ELECTRICAL DISTRIBUTION

TEST

This is a matching test, you are to write the alphabet in the space provided at the end of each statement that best describes the major parts of the electrical distribution system.

1. Provides the necessary energy to supply the island with electricity. ___
   a. Distribution lines
   b. Feeder lines
   c. Transmission lines
   d. Service lines
   e. Power plant

2. The conductors from the last pole to the premises. ___
   a. Distribution lines
   b. Feeder lines
   c. Transmission lines
   d. Service lines
   e. Power plant

3. Those conductors that include a neutral and equipment grounding conductors. ___
   a. Distribution lines
   b. Feeder lines
   c. Transmission lines
   d. Service lines
   e. Power plant

4. Those conductors that emerge from the power plant and possess the highest voltage in the system. ___
   a. Distribution lines
   b. Feeder lines
   c. Transmission lines
   d. Service lines
   e. Power plant

5. Those conductors that feeds the transformers on the power poles. ___
   a. Distribution lines
   b. Feeder lines
   c. Transmission lines
   d. Service lines
   e. Power plant

On the attached handout, place/write in the terms in the proper locations.
LESSON PLAN

LEVEL I INTRODUCTION TO ELECTRICITY

UNIT 8 Magnetism

Instructor Plan

Student Objectives:

a. State the laws of magnetism
b. State some applications of electromagnetism and how it can be strengthened.
c. Name the basic components of a DC generator and its function

Introduction

History: 200 BC Greeks discovered magnets and called them magnesia. Chinese, about 1100 AD called them leading stone and used by mariners as direction finders. Sometimes called magnetite or lode stones.

Characteristics: Two magnetic poles
- Repulsion
- Attraction
- Direction (north geographical pole)

a. Laws of magnetism
   a.1 Repulsion and attraction
   a.2 Lines of force
      Demonstration: place paper over bar magnet and pour iron fillings to form a pattern. Tap paper slightly.
   a.3 Magnetizing iron
      Align molecules
      Retentivity: Ability to retain magnetism
   a.4 Permeability: Ability to conduct magnetic field
      Magnetism has no known insulation
      Demonstration: experiment with magnet and glass, paper wood.

b. Electromagnetism
   b.1 Condition: When current flows through a conductor, a magnetic field is developed.
      Demonstration: with current flowing through a conductor and a compass or magnet.
      Left hand rule (current flow)
b.2 Strength of magnetic field depends on the following conditions:
   Source
   Number of turns of wires
   Type of iron core and size of core
Demonstration: experiment with pencil and nail to show strength of electromagnets. #1 Science Activities, #4 Science Activities

b.3 Applications of electromagnets
   Relays
   Coils
   Vibrating bells
   Solenoids

C. DC Generator
   c.1 Definition: A machine designed for generating direct-current. Electricity.
   c.2 Three condition necessary for generating electric current.
      Magnetic field
      Closed circuit
      Motion
   c.3 Basic concept
      When a conductor is moved through a magnetic field, a voltage is induced in the conductor
   c.4 Four basic parts of a DC generator
      Wire loop
      Magnetic field
      Commutator
      Brushes

Student Project: Conduct experiments 1 or 4. Explain concept of experiments.
LEVEL I  INTRODUCTION TO ELECTRICITY

UNIT H  MAGNETISM

TEST

The following 10 questions are multiple choice questions. You are to select the answer or answers which makes the statement correct.

1. The region of influence around a magnet is called _______________.
   a. Resistance
   b. Reluctance
   c. Magnetic field
   d. Field of force

2. Some magnets are found in its natural form, these are referred to as _______________.
   a. Lime stone
   b. Load stone
   c. Lead stone
   d. Wheat stone

3. Magnets with like poles will _______________.
   a. Repel
   b. Attract
   c. Neutralize

4. If allowed to swing freely, a magnet will align itself so that its _______________ pole points toward the geographical north pole.
   a. South
   b. North

5. A magnet is a material which is surrounded by a _______________.
   a. Electric current
   b. Magnetic field
   c. Conductive field
   d. Inductive field

6. When electric current passes through a wire, a _______________ is produced.
   a. Conductive field
   b. Inductive field
   c. Magnetic field
   d. Armature field

7. A basic rule of magnetism is that like poles _______________ while unlike poles _______________.
   a. Attract and repel
   b. Repel and attract
   c. Attract and attract

Briefly answer the following four questions.

8. Define permeability:
9. List at least four examples where electromagnets are used in electrical installations.
   a.
   b.
   c.
   d.

10. Name the basic components of a DC Generator.

11. Refer to question 10 and describe the function of each component.
HOW MUCH STRONGER IS AN ELECTROMAGNET MADE ON A BOLT THAN ON A PENCIL?

MATERIALS:
6 Meters #24 enameled copper wire, fine sandpaper, 1 D cell, masking tape, brads or tacks, 3" bolt, pencil, compass

Make an electromagnet on the pencil like this:

Test it's strength with brads or tacks!

Make an electromagnet on the bolt like this. Test it, too!

Can you think of ways to make your electromagnet stronger?

See how far away from a compass you can hold either and get results.

Save your electromagnet for future activities.
WHAT IS THE MOST YOU CAN MAKE USING A MAGNET AND A COIL?

MATERIALS:
Electric meter from Activity 2
Small bar magnet, masking tape, fine sandpaper
3 Meters #24 enameled copper wire

Do this first:

What happens to the compass needle? Try any way you can think of to make the needle swing. How far can you make it go?
LESSON PLAN

LEVEL I  INTRODUCTION TO ELECTRICITY

UNIT 10  Low Voltage Circuit

Instructor Plan

Student Objectives:

- State the uses of low voltage circuits in residential wiring and other applications.
- State the procedure in wiring a signal circuit.
- Name three different types of signal devices used in residential wiring.
- List the equipment and supplies needed for wiring a low voltage signal circuit.

Use of low voltage circuits

a. Used in residential dwellings
b. Used in office buildings
c. Used in industrial plans

Procedures in wiring signal circuits

a. Three rules for wiring signal circuits
   a1. Connect a conductor to one side of source to signal device.
   a2. Connect a conductor from other side of source to pushbutton or control point.
   a3. Connect a conductor from pushbutton to signal device.
   a4. Diagram

   
   Operation of signal devices

a. Vibrating bell
b. Buzzer
c. Door chimes
   c1. Single-tone
   c2. Two-tone
   c3. Multi-tone
Signal circuit equipment

a. Transformers
   a1. Voltage rating
   a2. Volt-ampere rating

b. Wire/conductor
c. Pushbutton

NEC requirement

a. Article 725

Student Application

a. Construct a low voltage circuit
LEVEL I  INTRODUCTION TO ELECTRICITY

UNIT 10  LOW VOLTAGE CIRCUITS

Objective: Install wiring using low voltage equipment.

PLAN

1. Complete the wiring diagram on the right.
2. Have instructor check diagram. OK
3. Complete material list and cost in classroom using materials catalog.
4. Gather materials in shop and complete wiring on board.
5. Have instructor check wiring before energizing circuit. OK
6. Replace all materials from project to it's proper storage.
7. Answer questions listed below.
8. Turn project sheet to instructor for grade.

MATERIALS - LIST THEM DOWN ACCORDING TO CATALOG NAMES

1.  6.  11.
2.  7.  12.
3.  8.  13.
5. 10.  15.

QUESTIONS:

1. What size conductors are normally used in this type of wiring?
3. If the resistance of the chimes is 3 ohms, what would the current be? Work your problem on this sheet.
APPENDIX C

LESSON PLAN

LEVEL I INTRODUCTION TO ELECTRICITY

UNIT 11 USE AND CARE OF TEST INSTRUMENTS AND EQUIPMENT

Instructor Plan

Student Objectives:

1. State the importance of proper handling and transporting of meters.
2. Describe the reason for zeroing the meter.
3. Demonstrate the use of each scale on a meter.
4. Distinguish between positive terminals and negative terminals either through color code or symbols.
5. Demonstrate the ability to safely and properly measure voltage across a load.

Introduction:

Importance of knowing what to do before selecting and using any test instrument or equipment.
Importance of safety procedure.
Importance of reading manual before operating instrument.

1. Handling and transporting meters
   1.1 Expensive and delicate instrument
   1.2 The heart of an electrician
   1.3 Set selector switch for "off" or "transit" when not in use
   1.4 Demonstrate

2. Zeroing the meter:
   2.1 Accuracy: Always zero meter before using
   2.2 Zero meter when changing scale (accuracy)
   2.3 Always observe meter movement
   2.4 Demonstrate zeroing in of meter (Ohm/resistance scale)

4. Scale setting/range selection
   4.1 Predetermine reading and set scale to highest range
   4.2 Before testing, predetermine where pointer should point
   4.3 Observe meter movement
   4.4 Demonstrate range selection on live circuit

5. Identifying polarity
   5.1 Observe polarity when measuring DC sources
5.2 Red leads for positive and black leads for negative
5.3 Always double check colors of test leads
5.4 Demonstrate with DC batteries

6. Measuring voltage

6.1 Always select highest voltage range when beginning test
6.2 Observe meter movement
6.3 Select range which gives the most accurate reading
6.4 Always measure across the load (parallel)
6.5 Demonstrate with DC batteries

7. Measuring current

7.1 Always have meter in series with the load
7.2 Observe meter movement
7.3 Select highest range first
7.4 Demonstrate with amprobe on lite circuit in shop

8. Measuring resistance

8.1 Always zero meter first before testing
8.2 Observe meter movement
8.3 Always check for voltage first before measuring resistance
8.4 Always turn meter to off position or transit when not in use
8.5 Demonstrate with resistors

9. Proper storing

9.1 Always turn meter off or on transit before storing
9.2 Meter face should be facing up
9.3 Storage area should be cool and dry (humidify air if possible)
9.4 Do not place anything on meters
9.5 Demonstrate

Have students read manuals and practice taking measurements.
LESSON PLAN

LEVEL I INTRODUCTION TO ELECTRICITY

UNIT 12 ELECTRICAL SYMBOLS

Instructor Plan:

Student Objectives:

Identify and draw the following symbols:

1. Introduction:
   Used as an international language by electrical workers
   Faster to draw symbols than actual objects
   Electricians should know as many symbols as possible

   a. Single pole switch

      Draw symbol of a single pole switch on chalkboard
      Show actual switch to students
      Have students draw symbols in notebook. Stress neatness

   b. Double pole switch

      Draw a symbol of a double pole switch on chalkboard
      Show actual switch to students
      Have students draw symbols in notebook

   c. Three-way switch:

      Draw a symbol of a three-way switch on chalkboard
      Show actual switch to students
      Have students draw symbol in notebook

   d. Four-way switch

      Draw a symbol of a four-way switch on chalkboard
      Show actual switch to students
      Have students draw symbols in notebook

   e. Duplex receptacle

      Draw a symbol of a duplex receptacle on chalkboard
      Show actual receptacle to students
      Have students draw symbols in notebook

   f. Special purpose receptacle

      Draw symbol for a special purpose receptacle on chalkboard
Show dryer or range receptacle to students
Have students draw symbol in notebook

g. Split circuit receptacle

Draw a symbol of a split circuit receptacle on chalkboard
Show actual split circuit receptacle to students
Have students draw symbol in notebook

h. Clock outlet

Draw a symbol of a clock outlet on chalkboard
Show actual clock outlet to students
Have students draw clock outlet in notebook

i. Floor outlet

Draw a symbol of a floor outlet on chalkboard
Show actual floor outlet to students
Have students draw floor outlet in notebook.

j. Lighting outlet

Draw a symbol of a lighting outlet on chalkboard
Show actual lighting outlet to students
Have students draw lighting outlet in notebook

k. Lighting panel

Draw a symbol of a lighting panel on chalkboard
Show actual lighting panel to students
Have students draw symbol in notebook

l. Low voltage pushbutton

Draw a symbol of a low voltage pushbutton on chalkboard
Show actual pushbutton to students
Have students draw symbol in notebook

m. Lampholder

Draw a symbol of a lampholder on chalkboard
Show actual lampholder to students
Have students draw symbol in notebook

n. Weatherproof receptacle

Draw a symbol of a weatherproof receptacle on chalkboard
Show students actual weatherproof receptacle
Have students draw symbol in notebook
o. Fan outlet

Draw a symbol of a fan outlet on chalkboard
Show students actual fan outlet
Have students draw symbol in notebook

p. Junction box

Draw a symbol of a junction box on chalkboard
Show actual junction boxes to students
Have students draw symbol in notebook

q. Bell or Buzzer

Draw a symbol of a bell and buzzer on chalkboard
Show actual bell and buzzer to students
Have students draw symbols in notebook

r. Transformer LV

Draw a symbol of a transformer on chalkboard
Show actual transformer to students
Have students draw symbol in notebook

Review and summarize lesson with students

Administer examination
LEVEL I  INTRODUCTION TO ELECTRICITY
UNIT 12  ELECTRICAL SYMBOLS

TEST

Draw the electrical symbols for the following items:

1. Floor outlet
2. Four-way switch
3. Lighting panel
4. Weatherproof receptacle
5. Special purpose outlet
6. Lampholder
7. Clock outlet
8. Junction box
9. Single pole switch
10. Three-way switch
11. Duplex receptacle
12. Lighting outlet
13. Low voltage pushbutton
14. Double pole switch
15. Split circuit receptacle
LESSON PLAN

LEVEL II  ELECTRICAL PRINCIPLES AND PRACTICES

UNIT 4  INTRODUCTION TO THE NATIONAL ELECTRICAL CODE AND STANDARDS

Instructor Plan

Student Objectives:

a. State the purpose of the NEC.
b. Identify those areas that are covered and those that are not covered by the NEC.
c. Explain how the code is arranged and state specific articles used in general wiring practices.
d. Define terms used in the NEC which pertain to residential wiring.
e. State the difference between mandatory and recommended rules and its application.
f. State procedure for filing for a formal code interpretation.

Introduction:

Minimum standard for electrical work
Providing a system which is essentially free from hazards
Accepted standards by most authorities having jurisdiction
Standard when taking a journeyman's license
Most widely used standard

1. Purpose: Art. 90-1

1.1 Practical safe guarding of persons
1.2 Building and content
1.3 Provide a system that is free from shorts and grounds

2. Scope: Art. 90-2

2.1 Coverage of the CODE

a. Electric conductors
b. Equipment within public buildings
c. Industrial substations
d. Carnivals and yards
e. Dwellings, apartments, hotels, etc.

2.2 Not covered

a. Ships
b. Watercrafts
c. Railways
d. Mines

3. Code arrangement: Art. 90-3
   3.1 Individual chapters (9)
   3.2 Chapters 1, 2, 3, and 4 general requirements
   3.3 Chapters 5, 6, 7 apply to special occupancies
   3.4 Chapter 8 deals with communications
   3.5 Chapter 9 deals with Tables

4. Definitions: Art. 100
   4.1 Define terms used more than once in Code
   4.2 Electrical installation dictionary

5. Fundamental rules: Art. 110
   5.1 "1" in the beginning of each article covers the fundamental rule for that article
   5.2 Mandatory statement uses the word "shall"
   5.3 Recommended practice uses the word "should"

6. Interpretation: Art. 90-5
   6.1 Procedure for formal interpretation
   6.2 May be necessary when there is a dispute in local interpretation

7. Enforcement: 90-4
   7.1 Local government

8. Examination of equipment for safety: Art. 90-6
   8.1 Purpose to safeguard against defective equipment
   8.2 Examination done by testing labs such as UL or other private testing labs.

9. Wiring planning: Art. 90-7
   9.1 Reasons for adequate wiring
   9.2 Ample size raceways being provided
   9.3 Allowance for future increase in the use of electricity

10. Revision of the NEC:
    10.1 Purpose for revision
    10.2 Technological changes
10.3 New research and findings
10.4 Changes made every three years

11. History of the NEC

11.1 Student assignment and report
11.2 NEC originally drawn in 1897 by insurance, electrical, architectural, and allied interests.
11.3 Original CODE prepared by the National Conference of Standard Electrical Rules.
11.4 1911 the National Conference was disbanded and the National Fire Protection Association (NFPA) sponsored the NEC.
11.5 Page xi NATIONAL ELECTRICAL CODE HANDBOOK Sixteenth Edition.
APPENDIX D SAMPLE ATTENDANCE AND PROGRESS CHARTS
APPENDIX D

SAMPLE ATTENDANCE AND PROGRESS SHEETS

Recording Student Progress

A major principle of vocational education is that the students learn skills or the performance of operations of a trade with the production job vehicle to accomplish this objective.

The operations are defined on the shop progress record and it is imperative that the instructor have some means of recording the student experiences and achievement.

The approved method of recording student progress is as follows:

☐ INSTRUCTED - This designation on the progress record indicates that the student has performed a skill with the assistance of and under the supervision of the instructor.

☐ PRACTICED - This designation on the progress records indicates that the student has performed a skill either alone or with little help from the instructor.

☐ PROFICIENT - This designation on the progress record indicates that the student is capable of performing a skill alone within a reasonable amount of time with no assistance from the instructor. In effect this implies that the student has been tested for that skill.

This method of noting student progress will define accurately student achievement and in fact will point out any weaknesses the student may have in certain operations; thus highlighting areas where the student may need help.

Grades should be kept on student daily progress cards or in roll books.
<table>
<thead>
<tr>
<th>STUDENT</th>
<th>TOOL CHECK NO</th>
<th>LOCKER NO</th>
<th>TEXT BOOK NO</th>
<th>SHOP GRADES MARKING PERIOD</th>
<th>THEORY GRADES MARKING PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 2 3 4 F</td>
<td>1 2 3 4 1</td>
</tr>
</tbody>
</table>

200

131
PROGRESS RECORD INDEX

LEVEL I
CAREER ORIENTATION
SHOP ORIENTATION
SAFETY
USE AND CARE OF ELECTRICAL WIRING TOOLS
SOURCES OF ELECTRICITY
ELECTRICAL DISTRIBUTION
BASIC ELECTRICITY DC
MAGNETISM
ELECTRICAL DIAGRAMS
LOW VOLTAGE CIRCUITS
USE AND CARE OF TEST INSTRUMENTS AND EQUIPMENT
IDENTIFYING ELECTRICAL SYMBOLS
ELECTRICAL CONDUCTORS AND INSULATORS
ELECTRICAL TERMINATIONS
ELECTRICAL WIRING DEVICES AND MATERIALS
GUEST SPEAKERS
FIELD TRIPS

LEVEL II
SHOP ORIENTATION
SAFETY
BASIC ELECTRICAL THEORY AC
INTRODUCTION TO THE NEC AND STANDARDS
ELECTRICAL BLUEPRINT READING
ELECTRICAL TERMINATIONS
ELECTRICAL DIAGRAMS
ELECTRICAL WIRING DEVICES AND MATERIALS
OVERCURRENT PROTECTION
WIRING METHODS
GROUNDING
ELECTRICAL SERVICE SYSTEMS
TROUBLESHOOTING PROCEDURES
GUEST SPEAKERS
FIELD TRIPS

LEVEL III
SAFETY
PLANNING AND LAYING OUT ELECTRICAL CIRCUITS
ELECTRICAL SYSTEM ANALYSIS
ADVANCED INTERPRETATION OF THE NATIONAL ELECTRICAL CODE
WIRING A RESIDENTIAL UNIT/DWELLING
LIGHTING FIXTURES
RENOVATION AND TROUBLESHOOTING
JOB ACQUISITION SKILLS
ADVANCED ELECTRICAL WIRING
GUEST SPEAKERS
FIELD TRIPS
<table>
<thead>
<tr>
<th>Level 1</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit 1</strong></td>
<td></td>
</tr>
<tr>
<td>a. Job description</td>
<td></td>
</tr>
<tr>
<td>b. Entry level requirement</td>
<td></td>
</tr>
<tr>
<td>c. Job ethics</td>
<td></td>
</tr>
<tr>
<td>d. Working condition</td>
<td></td>
</tr>
<tr>
<td>e. Job opportunity</td>
<td></td>
</tr>
<tr>
<td><strong>Unit 2</strong></td>
<td></td>
</tr>
<tr>
<td>a. Shop policy</td>
<td></td>
</tr>
<tr>
<td>b. Intro to course content</td>
<td></td>
</tr>
<tr>
<td>c. Grading policy</td>
<td></td>
</tr>
<tr>
<td>d. Books and references</td>
<td></td>
</tr>
<tr>
<td>e. Shop layout</td>
<td></td>
</tr>
<tr>
<td>f. Location of tools</td>
<td></td>
</tr>
<tr>
<td><strong>Unit 3</strong></td>
<td></td>
</tr>
<tr>
<td>a. Safety program</td>
<td></td>
</tr>
<tr>
<td>b. First aid</td>
<td></td>
</tr>
<tr>
<td>c. Ventilation and lighting</td>
<td></td>
</tr>
<tr>
<td>d. Material handling</td>
<td></td>
</tr>
<tr>
<td>e. Location of fire extinguishers</td>
<td></td>
</tr>
<tr>
<td><strong>Unit 4</strong></td>
<td></td>
</tr>
<tr>
<td>a. Screw driver</td>
<td></td>
</tr>
<tr>
<td>b. Phillips screw driver</td>
<td></td>
</tr>
<tr>
<td>c. Knife</td>
<td></td>
</tr>
<tr>
<td>d. Diagonal pliers</td>
<td></td>
</tr>
<tr>
<td>e. Long nose pliers</td>
<td></td>
</tr>
<tr>
<td>f. Side cutters</td>
<td></td>
</tr>
<tr>
<td>g. Lineman's pliers</td>
<td></td>
</tr>
<tr>
<td>h. Channel lock pliers</td>
<td></td>
</tr>
<tr>
<td>i. Torpedo level</td>
<td></td>
</tr>
<tr>
<td>j. Tape rule</td>
<td></td>
</tr>
<tr>
<td>k. Folding rule</td>
<td></td>
</tr>
<tr>
<td>l. Chisels</td>
<td></td>
</tr>
<tr>
<td>m. Hammer</td>
<td></td>
</tr>
<tr>
<td>n. Keyhole saw</td>
<td></td>
</tr>
<tr>
<td>o. Wire stripper</td>
<td></td>
</tr>
<tr>
<td>p. Hack saw</td>
<td></td>
</tr>
<tr>
<td>q. Vice-grip pliers</td>
<td></td>
</tr>
<tr>
<td>r. Tool pouch</td>
<td></td>
</tr>
<tr>
<td>s. Fish tape</td>
<td></td>
</tr>
<tr>
<td>t. Portable electric drill</td>
<td></td>
</tr>
<tr>
<td>UNIT</td>
<td>1</td>
</tr>
<tr>
<td>------</td>
<td>---</td>
</tr>
<tr>
<td>a.</td>
<td>Friction</td>
</tr>
<tr>
<td>b.</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td></td>
</tr>
<tr>
<td>f.</td>
<td></td>
</tr>
<tr>
<td>g.</td>
<td></td>
</tr>
<tr>
<td>UNIT</td>
<td>8</td>
</tr>
<tr>
<td>a.</td>
<td>Power plant</td>
</tr>
<tr>
<td>b.</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td></td>
</tr>
<tr>
<td>f.</td>
<td></td>
</tr>
<tr>
<td>UNIT</td>
<td>15</td>
</tr>
<tr>
<td>a.</td>
<td>Batteries</td>
</tr>
<tr>
<td>b.</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td></td>
</tr>
<tr>
<td>UNIT</td>
<td>22</td>
</tr>
<tr>
<td>a.</td>
<td>Law of Mag.</td>
</tr>
<tr>
<td>b.</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td></td>
</tr>
<tr>
<td>UNIT</td>
<td>29</td>
</tr>
<tr>
<td>a.</td>
<td>Operation of sig. devices</td>
</tr>
<tr>
<td>b.</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td></td>
</tr>
<tr>
<td>UNIT</td>
<td>36</td>
</tr>
<tr>
<td>a.</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td></td>
</tr>
</tbody>
</table>
## PROGRESS CHART
### INTRODUCTION TO ELECTRICITY

#### LEVEL I

| 1    |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 2    |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 3    |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 4    |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 5    |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 6    |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 7    |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 8    |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 9    |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 10   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 11   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 12   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 13   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 14   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 15   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 16   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 17   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 18   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 19   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 20   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 21   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 22   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 23   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 24   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 25   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 26   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 27   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 28   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 29   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 30   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 31   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 32   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 33   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 34   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 35   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 36   |             |                |               |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**APPENDIX D**
<table>
<thead>
<tr>
<th>Chart</th>
<th>Progress</th>
<th>Chart</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>UNIT 1</td>
<td>2</td>
<td>UNIT 1</td>
</tr>
<tr>
<td></td>
<td>a. Shop policy</td>
<td></td>
<td>b. Intro to course content</td>
</tr>
<tr>
<td></td>
<td>b. Intro to course content</td>
<td></td>
<td>c. Grading policy</td>
</tr>
<tr>
<td></td>
<td>c. Grading policy</td>
<td></td>
<td>d. Books and references</td>
</tr>
<tr>
<td></td>
<td>d. Books and references</td>
<td></td>
<td>e. Shop layout</td>
</tr>
<tr>
<td></td>
<td>e. Shop layout</td>
<td></td>
<td>f. Location of tools</td>
</tr>
<tr>
<td></td>
<td>f. Location of tools</td>
<td></td>
<td>UNIT 2</td>
</tr>
<tr>
<td></td>
<td>g. First aid</td>
<td></td>
<td>a. Safety program</td>
</tr>
<tr>
<td></td>
<td>h. Ventilation and lighting</td>
<td></td>
<td>b. First aid</td>
</tr>
<tr>
<td></td>
<td>i. Material hand. and storage</td>
<td></td>
<td>c. Ventilation and lighting</td>
</tr>
<tr>
<td></td>
<td>j. Location of fire extinguishers</td>
<td></td>
<td>d. Material hand. and storage</td>
</tr>
<tr>
<td></td>
<td>k. Uses of AC curr.</td>
<td></td>
<td>UNIT 3</td>
</tr>
<tr>
<td></td>
<td>l. Cycle</td>
<td></td>
<td>a. Purpose of NEC</td>
</tr>
<tr>
<td></td>
<td>m. Frequency</td>
<td></td>
<td>b. Scope</td>
</tr>
<tr>
<td></td>
<td>n. Phase</td>
<td></td>
<td>c. Code arrangement</td>
</tr>
<tr>
<td></td>
<td>o. Voltage</td>
<td></td>
<td>d. Definition</td>
</tr>
<tr>
<td></td>
<td>p. Transformers</td>
<td></td>
<td>e. Fundamental rules</td>
</tr>
<tr>
<td></td>
<td>q. Inductance</td>
<td></td>
<td>f. Interpretation</td>
</tr>
<tr>
<td></td>
<td>r. Capacitance</td>
<td></td>
<td>g. Enforcement</td>
</tr>
<tr>
<td></td>
<td>UNIT 4</td>
<td></td>
<td>h. Exam of equip. for safety</td>
</tr>
<tr>
<td></td>
<td>a. Purpose of NEC</td>
<td></td>
<td>i. Wiring planning</td>
</tr>
<tr>
<td></td>
<td>b. Scope</td>
<td></td>
<td>j. Revision of the NEC</td>
</tr>
<tr>
<td></td>
<td>c. Code rules</td>
<td></td>
<td>k. History of the NEC</td>
</tr>
<tr>
<td></td>
<td>d. Definition</td>
<td></td>
<td>UNIT 5</td>
</tr>
<tr>
<td></td>
<td>e. Fundamental rules</td>
<td></td>
<td>a. Intro to blueprint</td>
</tr>
<tr>
<td></td>
<td>f. Interpretation</td>
<td></td>
<td>b. Material description</td>
</tr>
<tr>
<td></td>
<td>g. Enforcement</td>
<td></td>
<td>c. Scales</td>
</tr>
<tr>
<td></td>
<td>h. Exam of equip. for safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>i. Wiring planning</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>j. Revision of the NEC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>k. History of the NEC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>UNIT 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Intro to blueprint</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Material description</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. Scales</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>d. Types of drawings</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>e. Calculation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NAME</td>
<td>UNIT 1</td>
<td>2</td>
<td>UNIT 2</td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>---</td>
<td>--------</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX E HANDOUTS
APPENDIX E

Electrical Symbols Commonly Used on Blueprints

GENERAL OUTLETS

C Ring - Wall

Outlet
Blanked Outlet
Drop Cord
Electrical Outlet; for use only when circle used alone might be confused with columns, plumbing symbols, etc.
Fan Outlet
Junction Box
Lamp Holder
Lamp Holder with Pull Switch
Pull Switch
Outlet for Vapor Discharge Lamp
Exit Light Outlet
Clock Outlet. (Specify Voltage.)

CONVENIENCE OUTLETS

Duplex Convenience Outlet
Convenience Outlet other than Duplex
Weatherproof Convenience Outlet
Range Outlet
Switch and Convenience Outlet
Radio and Convenience Outlet
Special Purpose Outlet. (Des. in Spec.)
Floor Outlet

SWITCH OUTLETS

Single Pole Switch
Double Pole Switch
Three-Way Switch
Four-Way Switch
Automatic Door Switch
Electrolier Switch
Key Operated Switch
Switch and Pilot Lamp
Circuit Breaker
Weatherproof Circuit Breaker
Momentary Contact Switch
Remote Control Switch
Weatherproof Switch
Fused Switch
Weatherproof Fused Switch

SPECIAL OUTLETS

Any Standard Symbol as given above with the addition of a lower case subscript letter may be used to designate some special variation of Standard Equipment of particular interest in a specific set of Architectural Plans. When used, they must be listed in the Key of Symbols on each drawing and if necessary further described in the specifications.

PANELS, CIRCUITS, AND MISCELLANEOUS

Lighting Panel
Power Panel
Branch Circuit; Concealed in Ceiling or Wall
Branch Circuit; Concealed in Floor
Branch Circuit; Exposed
Home Run to Panel Board. Indicate number of Circuits by number of arrows. Note: Any circuit without further designation indicates a two-wire circuit. For a greater number of wires indicate as follows: 3 for (3 wires), etc.
Furnaces. Note: Use heavy lines and designate by number corresponding to listing in Feeder Schedule.
Underfloor Duct and Junction Box. Triple System. For double or single systems, eliminate 1 or 2 lines. This symbol equally adaptable to auxiliary system layouts.
Generator
Motor
Instrument
Power Transformer. (Or draw to scale.)
Controller
Isolating Switch

AUXILIARY SYSTEMS

Push Button
Buzzer
Bell
Annunciator
Outside Telephone
Interconnecting Telephone
Telephone Switchboard
Bell Ringing Transformer
Electric Door Opener
Fire Alarm Bell
Fire Alarm Station
City Fire Alarm Station
Fire Alarm Central Station
Automatic Fire Alarm Device
Watchman's Station
City Watchman's Central Station
Fire Alarm Central Station
Horn
Nurse's Signal Plug
Maid's Signal Plug
Radio Outlet
Signal Central Station
Interconnection Box
Battery

Special Auxiliary Outlets. Subscript letters refer to notes on plans or detailed description in specs.

Courtesy of American Standards Association of New York, N.Y.
APPENDIX E

ELECTRICAL

SERVICE DROP

ENTRANCE CAP

SERVICE MAST

INSULATOR BRACKET

HANDOUT 3

R16113

CONDUIT

MELL 171T IN

DISTRIBUTION PANEL

EMT CONDUIT

SERVICE DISCONNECT

DIsmauTlow

PANEL-

P

tir

A

IP

D.

JO

4

'ld

aRoup ILO

222

C.W.PIPE

GROUND ROD

222

145
SINGLE PHASE
120/240 VOLTS
3 WIRE, 100 AMPERE SERVICE.

SERVICE DROP

METER

SERVICE DISCONNECT

RANGE

BEDROOM

BATH

SPARE

SPARE

DISTRIBUTION PANELBOARD

GROUND ROD & C.W. PIPE

CIRCUIT BREAKER

FUSE

GROUND

SWITCH

CIRCUIT BREAKER

2 POLE
3-way switches controlling outlet located beyond both switches.

**NOTE:** This is a wiring method utilizing cables. On three wire cables, the red conductor is designated by black tracers.
NOTE: A single pole switch controlling a light with source at lighting outlet. In raceway wiring, all conductors to switches are colored. White conductors are not allowed to be connected to switches.
To install two ceiling lights on same line; one controlled by switch

To add new convenience outlets beyond old convenience outlets

To add a switch and convenience outlet beyond existing ceiling light

To add a new convenience outlet from an existing junction box

To add a switch and convenience outlet in one outlet box beyond existing ceiling light

To install one new ceiling outlet and two new switch outlets from existing ceiling outlet
Two ceiling lights controlled by individual switches. (2 gang switch)
Two three-way switches controlling one light. (raceway wiring)
One four-way and two three-way switches controlling one light. (raceway wiring)
<table>
<thead>
<tr>
<th>KIND OF FIRE</th>
<th>APPROVED TYPE OF EXTINGUISHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>...THEN CLICK THE COLUMNS TO THE RIGHT OF THAT CLASS</td>
<td></td>
</tr>
</tbody>
</table>

**CLASS A FIRES**
Use These Extinguishers
- Ordinary Combustibles
- Wood
- Paper
- Cloth, Etc.

<table>
<thead>
<tr>
<th>FOAM</th>
<th>CARBON DIOXIDE</th>
<th>SODA ACID</th>
<th>PUMP TANK</th>
<th>GAS CARTRIDGE</th>
<th>MULTI-PURPOSE DRY CHEMICAL</th>
<th>ORDINARY DRY CHEMICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solution of Aluminum Sulphate and Bicarbonate of Soda</td>
<td>Carbon Dioxide Gas Under Pressure</td>
<td>Bicarbonate of Soda Solution and Sulphuric Acid</td>
<td>Plain Water</td>
<td>Water Expelled by Carbon Dioxide Gas</td>
<td>Electrolytes, Etc.</td>
<td>Dry Chemical</td>
</tr>
</tbody>
</table>

**CLASS B FIRES**
Use These Extinguishers
- Flammable Liquids, Grease
- Gasoline
- Paints
- Oils, Etc.

**CLASS C FIRES**
Use These Extinguishers
- Electrical Equipment
- Motors
- Switches, Etc.
SAFE SHOP PRACTICES

1. Keep hands off all equipment unless assigned to work with.
2. De-energize all circuits before making repairs.
3. Use lockout switches and danger signs when working on circuits.
4. Cut only one electrical wire at a time. Neutral, then ground last.
5. Test all circuits before working on them.
6. Use fuse pullers for removing and replacing cartridge fuses.
7. Fuse all circuits according to code requirements.
8. Repair all circuit defects before replacing fuses.
10. Set all ladders properly before climbing them.
11. Use proper length ladder for each job. Top on ladder above knees.
13. Keep hands off all moving equipment such as belts and pulleys.
14. Leave hot soldering irons on proper rack for cooling.
15. Use tools for jobs they are designed for.
16. Wear goggles for all jobs that create eye hazards.
17. Ground all portable electric equipment.
18. Use proper materials for each job installation.
19. Abide by the National Electrical Code regulations for all electrical work.

FOLLOW ALL SAFETY RULES AND REGULATIONS...
SAMPLE RESUME

LEVEL III UNIT 8 JOB ACQUISITION SKILLS

NAME:

ADDRESS:

TELEPHONE:

PERSONAL:

Date of Birth:

Place of Birth:

Height:

Weight:

Marital Status:

Health:

OCCUPATIONAL OBJECTIVE:

EDUCATION:

HONORS AND ACTIVITIES:

WORK EXPERIENCE:

COMMUNITY SERVICE:

HOBBIES:

REFERENCE:
APPENDIX F SAFETY POSTERS
SAFETY PRECAUTIONS

NEVER CUT OFF THE THIRD PRONG.

SAFETY POSTER

MODERN HOMES HAVE THREE-WIRE RECEPTACLES.

USE ADAPTER ON OLD-TYPE RECEPTACLE.
If a hot wire is in contact with a vehicle and the occupant must get out quickly, he should leap without touching the car again.

To remove a downed wire from a victim, use a non-conductor such as a long dry wooden or plastic pole or a very dry tree branch.
APPENDIX G INSTRUCTIONAL RESOURCES
INSTRUCTIONAL RESOURCES

ELECTRICAL WIRING-HOMEBUILDING

BOOKS AND PRINTED MATTER


5. Electric Power Transmission and Distribution - Clarke Irwin and Company, Limited - P. O. Box 6137, Postal Station G, Vancouver, B.C. Canada

6. What is Electricity? - Frank E. Richards Publishing Co. - 324 First St., Liverpool, N.Y. 13088


14. Basic Electricity (Programmed Instruction) - Westinghouse Learning Corporation - 100 Park Avenue, New York, N.Y. 10017

15. Fundamentals of Electricity, Volume I (Programmed Instruction) - Addison-Wesley Publishing Co., Inc. - Reading, Mass. 01867


17. How AC and DC Circuits Work Vol. 2 (Programmed Instruction) - The Bobbs-Merrill Company, Inc. - 4300 West 62nd Street, Indianapolis, Ind. 46268

18. Understanding and Using Test Instruments (Programmed Instruction) - The Bobbs-Merrill Company, Inc. - 4300 West 62nd. St., Indianapolis, Ind. 46268


20. Questions and Answers for Electricians - Howard W. Sams and Company, Inc. - 4300 West 62nd. St., Indianapolis, Ind. 46268

21. New Electric Library, 10 volumes - The Bobbs-Merrill Company, Inc. - 4300 West 62nd. St., Indianapolis, Ind. 46268


23. Basic Electricity, Volume 1-5 - Van Valkenburgh, Nooger and Neville, Inc. - 15.Maiden Lane, New York, N.Y. 10038

24. Basic Electricity Theory and Practice - St. Martin's Press - 175 Fifth Ave., New York, N.Y. 10010

25. Electricity - Grosset and Dunlap, Inc. - 51 Madison Ave., New York, N.Y. 10010
ELECTRICAL WIRING-HOMEBUILDING

BOOKS AND PRINTED MATTER (cont'd)


30. Electric Wiring, Theory and Practice - Barnes and Noble - 105 Fifth Avenue, New York, N.Y. 10003

31. Facility and Curriculum Guidelines - State Department of Public Instructions, Olympia, Washington
1. **Electricity for Light and Heat** - Curriculum Materials Corp. - 1319 Vine Street, Philadelphia, Pa. 19107

2. **Static and Current Electricity** - Curriculum Materials Corp. - 1319 Vine Street, Philadelphia, Pa. 19107


7. **Diagramming Electrical Wiring Circuits** - Vocational Agricultural Service - University of Illinois - 434 Mumford Hall, Urbana, Ill. 61801

8. **Electrical Terms, Their Meaning and Use** - NASCO - Fort Atkinson, Wis. 53538

9. **AC and DC Generators** - Long Filmslide Service - 7505 Fairmont Avenue, El Cerrito, Calif. 94530

10. **AC Voltmeters and Ammeters** - Long Filmslide Service - 7505 Fairmont Avenue, El Cerrito, Calif. 94530

11. **Electricity (a series of 8)** - Long Filmslide Service - 7505 Fairmont Avenue, El Cerrito, Calif. 94530

12. **Electricity at Work** - Long Filmslide Service - 7505 Fairmont Avenue, El Cerrito, Calif. 94530

13. **Resistance** - Long Filmslide Service - 7505 Fairmont Avenue, El Cerrito, Calif. 94530

14. **Transformers** - Long Filmslide Service - 7505 Fairmont Avenue, El Cerrito, Calif. 94530
FILMSTRIPS (cont'd)

15. Magnetism, Electricity, and Machines - Bailey-Film Associates - 11559 Santa Monica Blvd., West Los Angeles, Calif. 90025

ELECTRICAL WIRING-HOMEBUILDING

ADDITIONAL FILMSTRIPS

Basic Electricity and Electronics Explained - Direct Current - Bergwall Productions, Inc., 839 Stewart Ave., Garden City, N.Y. 11530
ELECTRICAL WIRING-HOMEBUILDING

MOVIES

1. 400 Series, Basic Electricity (Super 8mm loop) - Animated Electronic Films - P.O. Box 2036, Eads Station, Arlington, Va. 22202

2. Series and Parallel Circuits (16mm reel) - Encyclopaedia Britannica Educational Corp. - 405 North Michigan Ave., Chicago, Ill. 60611

3. Electric Power Generation (16mm reel) - Serina Press - 70 Kennedy Street, Alexandria, Va. 22305

4. The World Behind Your Light Switch (16mm reel) - Serina Press - 70 Kennedy Street, Alexandria, Va. 22305

5. Connecting Wires in an Outlet Box (Super 8mm loop) - Jam Handy School Service, Inc. - 2781 East Grand Blvd., Detroit, Mich. 48211

6. Electrical House Wiring (Super 8mm loop) - Jam Handy School Service, Inc. - 2781 East Grand Blvd., Detroit, Mich. 48211

7. Installing a Convenience Outlet (Super 8mm loop) - Jam Handy School Service, Inc. - 2781 East Grand Blvd., Detroit, Mich. 48211

8. Outlet Box Installation (Super 8mm loop) - Jam Handy School Service, Inc. - 2781 East Grand Blvd., Detroit, Mich. 48211

9. Rewiring a Lamp (Super 8mm loop) - Jam Handy School Service, Inc. - 2781 East Grand Blvd., Detroit, Mich. 48211

10. The Third Wire Can Save Your Life (Super 8mm loop) - Jam Handy School Service, Inc. - 2781 East Grand Blvd., Detroit, Mich. 48211

11. Toggle Switch Installation (Super 8mm loop) - Jam Handy School Service, Inc. - 2781 East Grand Blvd., Detroit, Mich. 48211

12. Trouble-Shooting a Bell Circuit (Super 8mm loop) - Jam Handy School Service, Inc. - 2781 East Grand Blvd., Detroit, Mich. 48211
13. **Wiring a Box with Armored Cable (Super 8mm loop)** - Jam Handy School Service, Inc. - 2781 East Grand Blvd., Detroit, Mich. 48211

14. **Wiring an Attachment Plug (Super 8mm loop)** - Jam Handy School Service, Inc. - 2781 East Grand Blvd., Detroit, Mich. 48211

15. **Electrical Circuit Faults (16mm reel)** - United States National Audiovisual Center - National Archives and Records Service - Washington, D.C. 20409

16. **Electricity, Distribution (16mm reel)** - Indiana University Audiovisual Center - Field Services Dept., Bloomington, Ill. 47401

17. **Safety With Electricity (16mm reel)** - Encyclopaedia Britannica Educational Corporation - 405 North Michigan Avenue, Chicago, Ill. 60611

18. **Measurement of Electricity (16mm reel)** - Coronet Films - 65 E. South Water Street, Chicago, Ill. 60601

19. **Basic Electricity (16mm reel)** - United States National Audiovisual Center - National Archives and Records Service, Washington, D.C. 20409

20. **Basic Electricity, AC Parallel Circuits (16mm reel)** - United States National Audiovisual Center, National Archives and Records Service, Washington, D.C. 20409

21. **Basic Electricity, AC Series Circuits (16mm reel)** - United States National Audiovisual Center, National Archives and Records Service - Washington, D.C. 20409

22. **Fires and Wires (16mm reel)** - Henk Newenhouse/Novo - 1825 Willow Road, Northfield, Ill. 60093

23. **Danger Alive (16mm reel)** - Association Films, Inc. - 600 Madison Ave., New York, N.Y. 10022

24. **Electricity, Basic Wiring (16mm reel)** - Universal Education and Visual Arts - 221 Park Ave. So., New York, N.Y. 10003
A wide variety of 8mm loop films on Electricity are available from the following sources:

Sterling Educational Films
241 East 34th Street
New York, N.Y. 10016

Schoolmasters Science
745 State Circle
Ann Arbor, Michigan 48104

CENCO Educational Aids
2600 S. Kostner Ave.
Chicago, Ill. 60623

Rand McNally and Co.
405 Park Ave.
New York, N.Y. 10022
1. Electric Circuit - United Transparencies, Inc. - P.O. Box 688, Binghamton, N.Y. 13902
3. Inductance - DCA Educational Products, Inc. - 4865 Stenton Ave., Philadelphia, Pa. 19144
4. Production of Alternating and Direct Current - United Transparencies, Inc. - P.O. Box 688, Binghamton, N.Y. 13902
5. Generator - NASCO - Fort Atkinson, Wis. 53538
6. Simple Electric Generator - United Transparencies, Inc. - P.O. Box 688, Binghamton, N.Y. 13902
7. Electric Meter - CCM School Materials, Inc. - 2124 West 82nd Place, Chicago, Ill. 60620
8. Power Supply - United Transparencies, Inc. - P.O. Box 688, Binghamton, N.Y. 13902
10. Electrical Distribution - CCM School Materials, Inc. - 2124 West 82nd Place, Chicago, Ill. 60620
12. Electric Meters and Resistance - 3M Company - Visual Products Division, St. Paul, Minn. 55101
15. Basic Wiring - 3M Company - Visual Products Division - St. Paul, Minn. 55101
16. Circuits, In Series and Parallel - Creative Visuals - Box 1911, Big Spring, Texas 79720
TRANSPARENCIES (cont'd)

A wide variety of transparencies on Electricity are available from the following sources:

GAF Corporation Reprographic Products
140 West 51st Street
New York, N. Y. 10020

CENCO Educational Aids
2600 S. Kostner Avenue
Chicago, Illinois 60623

McGraw-Hill Films
8171 Redwood Highway
Novato, California 94947

DCA Educational Products, Inc.
4865 Stenton Avenue
Philadelphia, PA 19144

Stansi Scientific Division
1231 North Honore Street
Chicago, Illinois 60622

CCM School Materials, Inc.
2124 West 82nd Place
Chicago, Illinois 60620

Eye Gate House, Inc.
146-01 Archer Avenue
Jamaica, N. Y. 11435

George F. Cram Company, Inc.
School and Library Division
P. O. Box 426
Indianapolis, Indiana 46206

Tweedy Transparencies
208 Hollywood Avenue
East Orange, N. J. 07018
ELECTRICAL WIRING TOOLS

- Claw hammers
- Electrical drills (With wood and masonry bits)
- Hacksaws
- Keyhole saws
- Needle nose pliers
- Lineman's pliers
- Vise-grip pliers
- Wire cutters/stripers
- Diagonal pliers
- Screwdrivers
- Wood chisels
- Cold chisels
- Conduit benders
- Folding rules, 6 foot
- Cable ripper
- Utility knives
- Fish tape and reel
- Test lights
- Pipe removers
- Pipe threaders
- Pipe cutters
- Wire gauges
- Soldering irons (electrically heated)
- Soldering irons (torch heated)

SUPPLIES AND ACCESSORIES

- Solder (50/50)
- Soldering flux
- Vinyl electrician's tape
- Transformer models or cut-aways
- AC current source

WIRING DEVICES AND SUPPLIES

- Thin-wall conduit
- Rigid conduit
- Conduit, flexible metal (Greenfield)
- Soldering lugs
- Solderless connectors
- Cable (non-metallic sheathed) connectors
- Armored cable bushings and connectors
- Conduit connectors
- Conduit and cable clamps
- Service weather heads
- Ground electrodes
- Ground clamps
- Outlet boxes with covers
- Receptacle boxes with covers
- Meter sockets
- Single-pole switches with plates
- Three-way switches with plates
- Duplex receptacles with covers
- Two-circuit receptacles
- Porcelain lamp fixtures with pull chain
- Porcelain lamp fixtures (wall switch operated)
- Lighting fixtures (wall and ceiling mounted)
- 115/230 volt receptacles (30 and 50 ampere rated)
- Appliance pigtails
- Push buttons
- Signalling devices (bell or buzzer)
- Low voltage transformers
OVERCURRENT FIXTURES AND DEVICES

Fuse panels (or circuit breaker panels) 60 ampere
Fuse panels (or circuit breaker panels) 100 ampere
Fuse panels (or circuit breaker panels) 200 ampere
Meter socket and fuse panel combinations, 100 and 200 ampere
Single element fuses, Edison plug type 15, 20, 30 ampere
Time delay fuses, Edison plug type 15, 20, 30 ampere
Time delay fuses, cartridge type 36 to 60, 70, to 100, 110 to 200 amperes
Circuit breakers, single and 2-pole 15, 20, 30, 40, 60, 100 ampere

CONDUCTORS

Single conductor copper wire, insulated (10 gauge or smaller)
Single conductor copper wire, uninsulated (10 gauge or smaller)
Bell wire
Ground wire, uninsulated (No. 4, No. 6)
Armored cable, type ACT 10, 12, 14
Nonmetallic Sheathed Cable, Type NM, Type NMC
10-2, 12-2, 14-2, 10-2 w/ground, 12-2 w/ground, 14-2 w/ground
Wire, Type TW 12, 14
Cord, Type S 12-3
Cable, Type RHW 6-3

METERS

Kilowatthour meters
Milliammeters
AC Voltmeters
AC Ammeters
Ohmmeters
Megohmmeters
Light meters (foot candle meters)
NOTE: In addition to the previously listed equipment and supplies, the following instructional aids are recommended as possible additions to any course in electrical wiring derived from this curriculum. No attempt has been made to evaluate the relative merit of the following items; consequently, they should be examined for appropriateness prior to purchase.

**MOTOR AND GENERATOR DEMONSTRATION KIT**
**COPPER VOLTAMETER (Couleometer)**
**AMPERE'S FRAME APPARATUS**
**AMPERE'S LAW STAND, MOUNTED CONDUCTOR**
**DYNAMO ANALYSIS APPARATUS**
**LAWS OF RESISTANCE BOARD**
**TEMPERATURE COEFFICIENT OF RESISTANCE APPARATUS**
**DISSECTABLE TRANSFORMER**
**PHASE DEMONSTRATOR**

Available from CENCO Educational Aids
2600 S. Kostner Ave.
Chicago, Ill. 60623

**LINE DROP APPARATUS**

Available from STANSI Scientific Division
1231 North Honore Street
Chicago, Ill. 60622

**J-e EXPERIMENTER**
**3-e EXPERIMENTER MARK II**
**McKNIGHT POWER EXPERIMENTER**
Available from Mc Knight & Mc Knight Publishing Co., Bloomington, Ill. 61701

**STUDENT LABORATORY PROGRAM, ELECTRICITY AND MAGNETISM**
Available from SILVER BURDETT Co.
Box 362
Morristown, N. J. 07960

**ELECTRICAL CIRCUIT MODEL**
Available from DENOYER-GEPPERT Co.
5235 Ravenswood Ave.
Chicago, Ill. 60640

**CURRENT BALANCE**
Available from EDUQUIP INC.
1220 Adams Street
Boston, Mass. 02124
BIBLIOGRAPHY


<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Alternating current:</td>
<td>(AC) The term meaning that the current reverses at regular intervals.</td>
</tr>
<tr>
<td>2. Ampacity:</td>
<td>Current carrying capacity of electric conductors expressed in amperes.</td>
</tr>
<tr>
<td>3. Approved:</td>
<td>Acceptable to the authority having jurisdiction.</td>
</tr>
<tr>
<td>4. Cable:</td>
<td>Two or more conductors put together inside an overall covering usually moisture or flame retardant.</td>
</tr>
<tr>
<td>5. Circuit:</td>
<td>A complete path through which electricity flows, such as from the power source to a lamp, through the lamp, and back to the power source.</td>
</tr>
<tr>
<td>6. Circuit breaker:</td>
<td>A safety device which opens the circuit by tripping a switch rather than burning.</td>
</tr>
<tr>
<td>7. Conductor:</td>
<td>The wires which carry the electricity or through which electricity flows.</td>
</tr>
<tr>
<td>8. Conduit:</td>
<td>A metal or fiber pipe or tube used to enclose electrical conductors.</td>
</tr>
<tr>
<td>9. Cord:</td>
<td>Several small wires wrapped in insulation, then covered with another layer of insulation. Usually referred to as extension cords or lamp cords.</td>
</tr>
<tr>
<td>10. Device:</td>
<td>A unit of an electrical system which is intended to carry but not utilize electric energy. i.e. switches, plugs, fuses.</td>
</tr>
<tr>
<td>11. Direct current:</td>
<td>(DC) The term meaning that the current flows in one direction at a continuous rate.</td>
</tr>
<tr>
<td>12. Electricity:</td>
<td>A source of energy that can be easily converted into light, heat, or power.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>13. Equipment:</td>
<td><strong>A general term including materials, fittings, devices, appliances, fixtures, apparatus, and the like used as a part of, or in connection with, an electrical installation.</strong></td>
</tr>
<tr>
<td>14. Fish tape:</td>
<td><strong>A flat spring steel wire used to pull &quot;fish&quot; wires through conduits or walls.</strong></td>
</tr>
<tr>
<td>15. Fitting:</td>
<td><strong>Accessory such as a bushing, or lock-nut used on wiring system intended primarily to perform mechanical rather than electrical function.</strong></td>
</tr>
<tr>
<td>16. Fuse:</td>
<td><strong>A safety device which burns out when the current becomes too great.</strong></td>
</tr>
<tr>
<td>17. Hot wires:</td>
<td><strong>A current carrying conductor with electrical pressure on them.</strong></td>
</tr>
<tr>
<td>18. Insulation:</td>
<td><strong>A protective covering over wires to prevent completing a circuit except where desired.</strong></td>
</tr>
<tr>
<td>19. Junction box:</td>
<td><strong>An outlet box with a blank cover used to contain splices of a circuit.</strong></td>
</tr>
<tr>
<td>20. Knockout:</td>
<td><strong>Circular metal die-cut impression in outlet and switch boxes, not completely severed, which may be removed to accommodate wiring.</strong></td>
</tr>
<tr>
<td>21. Outlet:</td>
<td><strong>A point on the wiring system at which current is taken to supply utilization equipment. i.e. lighting outlet, receptacle outlets.</strong></td>
</tr>
<tr>
<td>22. Overload:</td>
<td><strong>Current demand which is greater than that for which the circuit or equipment was designed.</strong></td>
</tr>
<tr>
<td>23. Qualified person:</td>
<td><strong>Person who is thoroughly familiar with construction and operation of apparatus and hazards involved.</strong></td>
</tr>
<tr>
<td>24. Romex:</td>
<td><strong>Nonmetallic sheathed cable used for indoor wiring.</strong></td>
</tr>
<tr>
<td>25. Schematic diagram:</td>
<td><strong>Step used in electrical wiring showing the connections that needs to be made and usually used to trace flow of current when troubleshooting.</strong></td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Screw terminal:</td>
<td>Means for connecting wiring to devices, which makes use of a threaded screw.</td>
</tr>
<tr>
<td>Short circuit:</td>
<td>An improper connection between hot and neutral wires or between hot wires.</td>
</tr>
<tr>
<td>Single phase:</td>
<td>A type of electric service usually available to most residential dwellings requiring one transformer between power supplier and customers.</td>
</tr>
<tr>
<td>Skinning (wire):</td>
<td>Removing insulation</td>
</tr>
<tr>
<td>Splice:</td>
<td>Connection made by connecting two or more wires.</td>
</tr>
<tr>
<td>Switch:</td>
<td>A device used to open or close a circuit</td>
</tr>
<tr>
<td>Voltage drop:</td>
<td>A loss in electrical pressure from its source to its point of use.</td>
</tr>
<tr>
<td>Wire:</td>
<td>A single conductor which carries electricity.</td>
</tr>
<tr>
<td>Wire gauge:</td>
<td>A tool used to measure wire diameter</td>
</tr>
<tr>
<td>Wire size:</td>
<td>The measure of a wire diameter.</td>
</tr>
</tbody>
</table>