

COURSE OUTLINE

ELECTRIC MOTORS, ELECTRICAL
CIRCUITS AND CONTROLS
Course Title

AC 122
Dept. & Course No.

I. COURSE DESCRIPTION:

This course covers electrical symbols and electrical circuits used in air conditioning and refrigeration.

II. SEMESTER CREDITS: 3

III. CONTACT HOURS PER WEEK: $\frac{2}{\text{(Lecture)}}$ $\frac{3}{\text{(Lab.)}}$ $\frac{5}{\text{(Total)}}$

IV. PREREQUISITE: AC 111 and AC 112

V. STUDENT LEARNING OUTCOME :

Upon completion of the course,
the student will be able, with
65% accuracy to:

1. Define electrical and electronic terms.
2. Describe the difference between parallel circuits and series circuits.
3. Discuss the basic theory of electric motors and related devices.
4. Explain the use of computers in refrigeration controls.
5. List several types of electric motors.
6. List safety procedures for servicing electrical motors.

VI. COURSE CONTENT:

- A. Types of Electricity
- B. Circuits and Circuit Symbols
 1. Electrical Symbol
 2. Series Circuit
 3. Parallel Circuit
- C. The Elementary Electric Motor
- D. Computers
- E. Electric Motor Applications
 1. Motor Structure
 2. Types
- F. Electrical Hazards
 1. Electricity as a Source
 2. Electrical Shock

7. Use various electrical testing instrument to check motor windings, shorts and grounds.

8. Identify the common types of electrical circuit controls used in refrigeration and air conditioning.

9. Read and understand electrical circuitry.

10. Adjust various refrigeration control.

11. Service and repair various electrical control.

G. Servicing Electric Motors

1. Testing Capacitors
2. Testing Compressors
3. Motor Lubrication
4. Fan Motors

H. Electrical Circuits

1. Refrigerator
2. Freezer
3. Water Cooler
4. Window Type AC
5. Split Type AC

I. Wiring Diagrams

1. Standard Electrical Circuit Diagram
2. Ladder Diagram

J. Refrigeration Controls Setting and Adjustment

K. Procedures in Servicing Repairing Electrical Controls

1. Domestic Refrigerators
2. Freezers
3. Air Conditioners

VII. EQUIPMENT AND MATERIALS:

- A. Refrigeration Basic Hand Tools
- B. Refrigeration and AC units which uses Refrigerant number 11, 12, 22, 134a, 410A and 502
- C. Programmable Weighing Scale
- D. DOT approve Cylinders
- E. Refrigerant Recovery Station
- F. Ultrasonic Leak Detector
- G. Portable Refrigerant Recovery and Recycling Unit
- H. Refrigerant Recovery Equipment Designed for Automotive AC
- I. Electronic Thermometer
 1. Glass Stem Thermometer with range form 40 to 210 'F and 40 to 100 Celsius
 2. Kelvin and Rankine Thermometer
- J. Tape Rule: US standard and Standard International
- K. Pressure Gauge
- L. Compound Gauge

- M. Fundamentals of Refrigeration Trainer
- N. Microcomputer with DVD Player
- O. Electronic Vacuum Gauge
- P. Bourdon Spring Gauge
- Q. Air Conditioners
- R. Air Conditioning Simulator
- S. Refrigeration Simulator
- T. Routine Classroom Materials
- U. Assorted fittings
- V. ACR tubing
- w. Refrigerants. 12, 22, 134a
- X. Evaporator repair kit
- Y. Oxy acetylene gas
- Z. Brazing rods; silver, bronze
- AA. Abrasives
- BB. Cleaning solvents
- CC. Machine bolts and cap screws
- DD. Refrigeration oil
- EE Vacuum pump
- FF. Pressure washer
- GG. Air compressor
- HH. Spray gun
- II. Paints
- JJ. Electrical supplies

VIII. TEXT AND REFERENCES:

A. TEXT:

Althouse, A.D. , et. al. Modern Refrigeration and Air Conditioning. South Holland, Ill.: Goodhearted Wilcox Publishing Company, Inc., 2004.

B. REFERENCES:

Miller, Rex. Rex. Refrigeration and Air Conditioning Technology. Peoria, Ill.: Bennett and McKnight Publishing Company, 1990.

Warren, Marsh and Olivo, C. T. Principles of Refrigeration. Albany, New York: Delmar Publishers 1985.

Kamp, J. L. Refrigeration and Air Conditioning Laboratory Manual. Toledo, Ohio: Thermal Engineering Co., 1980.

IX. METHOD OF INSTRUCTION:

- A. Lecture
- B. Discussion
- C. Demonstration
- D. Audio Visual
- E. Performance

X. METHOD OF EVALUATION:

Four criteria considered in evaluating projects and performance of operation are:

- A. Accuracy
- B. Techniques
- C. Appearance
- D. Completion

Components with corresponding weight in percent included in the computation of the final grades are:

<u>Components</u>	<u>Weight</u>
Participation	15%
Quizzes	10%
Mid-tern and Final exams	20%
Projects	55%

	Total = 100%

The transmutation of total percent to letter grade is as follows:

<u>Weight</u>	<u>Letter Grade</u>
90% - 100%	A
80% - 89%	B
70% - 79%	C
65% - 69%	D
0% - 64%	F

TASKS LIST

<u>Task</u>	<u>Time</u>
Student Learning Outcome No. 2 and 7	10 hrs
<ol style="list-style-type: none">1. Build the parallel electrical lighting circuit2. Measure the voltage across any leg of the parallel circuit.3. Built the series of electrical lighting circuit.4. Measure the current on a parallel circuit.5. Measure the voltage across any leg of a series circuit.	
Student Learning Outcome No. 6and 7	7 hrs.
Trace a 120 volt refrigeration circuit	
<ol style="list-style-type: none">A. Cabinet light circuit.B. Motor control, thermostat and motor compressor circuit.C. Condenser fan circuit.	
Student Learning Outcome No. 8	8 hrs
<ol style="list-style-type: none">1. Repair hermetic motor;<ol style="list-style-type: none">A. Replace relay.B. Replace overload protectorC. Replace capacitor.2.. External test motor compressor.3. Start the motor and verify proper operation4. Dismantle and assemble a single phase motor.	
Student Learning Outcome Nos. 9,10. and 11	23 hrs.
<ol style="list-style-type: none">1. Check and replace electrical component.2. Test electrical wiring.3. Construct a pictorial and ladder diagram of the following<ol style="list-style-type: none">A. RefrigeratorB. FreezerC. Water CoolerD. Window Type ACE. Split Type AC	
Total	48 hrs.

**Course Level Achievement
Form A
(Used for shop courses as well as other program courses)**

AC 122- Electric Motors, Electrical Circuits and Controls

Student Name: _____

Semester/Year: _____

Instructor's Name (Print): _____

Directions: Assess the student using the rating scale below and check the appropriate numbers to indicate the degree of competency. The numerical ratings of 5, 4, 3, 2, and 1 are not intended to represent the traditional school grading system of A, B, C, D, and F. The descriptions associated with each of the numbers focus on the level of student performance for each of the competencies listed below.

Rating Scale: 5 Excellent
 4 Above average
 3 Average
 2 Below average
 1 Unacceptable

- **Passing Achievement:** A student must achieve at least a numerical value level of 3 in all the course competencies in order to pass this course. Through weekly progress report, students who are barely passing or failing the course are referred to Counseling Services for assistance.

COMPETENCIES	RATINGS
A. Use volt ohm meter (VOM) to test for short, ground, identify terminals, test run the motor and measure the current using Clamp meter	5 4 3 2 1
B. Demonstrate the ability to inspect, service or repair repulsion type motor.	5 4 3 2 1
C. Demonstrate the ability to inspect, replace capacitor run, capacitor start and capacitor run/start motor.	5 4 3 2 1
D. Draw, read and interpret common schematic types of electrical diagrams.	5 4 3 2 1
E. Use air conditioning and refrigeration program to simulate electric motor problems commonly encountered in the field, apply the test procedures and test the actual unit.	5 4 3 2 1

I certify that the student has completed all the competencies in this program and has achieved an average rating as shown on the right.

Instructor's Signature

Date

AC 122- Electric Motor, Electric Circuits and Controls

A. Use volt ohm meter (VOM) to test for short, ground, identify terminals, run the motor and measure the current using clamp meter.

- 5 Use volt ohm meter (VOM) to test for short, ground, identify terminals, run the motor and measure the current using clamp meter with 90-100% accuracy
- 4 Use volt ohm meter (VOM) to test for short, ground, identify terminals, run the motor and measure the current using clamp meter with 80-89% accuracy
- 3 Use volt ohm meter (VOM) to test for short, ground, identify terminals, run the motor and measure the current using clamp meter with 70-79% accuracy
- 2 Use volt ohm meter (VOM) to test for short, ground, identify terminals, run the motor and measure the current using clamp meter with 65-69% accuracy
- 1 Use volt ohm meter (VOM) to test for short, ground, identify terminals, run the motor and measure the current using clamp meter with below 65% accuracy.

B. Demonstrate the ability to inspect, service or repair repulsion type motor.

- 5 Inspect, repair or replace parts of repulsion type electric motor, energize the power and check the proper locked rotor amperes and full load amperes as stated in the motor data plate for proper operation with 90-100% accuracy.
- 4 Inspect, repair or replace parts of repulsion type electric motor, energize the power and check the proper locked rotor amperes and full load amperes as stated in the motor data plate for proper operation with 80-89% accuracy.
- 3 Inspect, repair or replace parts of repulsion type electric motor, energize the power and check the proper locked rotor amperes and full load amperes as stated in the motor data plate for proper operation with 70-79% accuracy.
- 2 Inspect, repair or replace parts of repulsion type electric motor, energize the power and check the proper locked rotor amperes and full load amperes as stated in the motor data plate for proper operation with 65-69% accuracy.
- 1 Inspect, repair or replace parts of repulsion type electric motor, energize the power and check the proper locked rotor amperes and full load amperes as stated in the motor data plate for proper operation with below 65% accuracy.

C. Demonstrate the ability to inspect, repair or replace capacitor run, capacitor start and a capacitor run/start electric motor.

5. Inspect, repair or replace parts of capacitor run, capacitor start, and a capacitor start capacitor run electric motor, energize the power and check the proper locked rotor amperes and full load amperes as stated in the motor data plate for proper operation with 90-100% accuracy.
4. Inspect, repair or replace parts of capacitor run, capacitor start, and a capacitor start capacitor run electric motor, energize the power and check the proper locked rotor amperes and full load amperes as stated in the motor data plate for proper operation with 80-89% accuracy.
3. Inspect, repair or replace parts of capacitor run, capacitor start, and a capacitor start capacitor run electric motor, energize the power and check the proper locked rotor amperes and full load amperes as stated in the motor data plate for proper operation with 70-79% accuracy.
2. Inspect, repair or replace parts of capacitor run, capacitor start, and a capacitor start capacitor run electric motor, energize the power and check the proper locked rotor amperes and full load amperes as stated in the motor data plate for proper operation with 65-69% accuracy.
1. Inspect, repair or replace parts of capacitor run, capacitor start, and a capacitor start capacitor run electric motor, energize the power and check the proper locked rotor amperes and full load amperes as stated in the motor data plate for proper operation with below 65% accuracy.

D. Draw, read and interpret common types of electrical diagrams in schematic form.

- 5 Draw, read and interpret schematic wiring diagram of domestic refrigerator, household freezer, water dispenser, window type air conditioner, and split type air conditioner with 90 - 100% accurate
- 4 Draw, read and interpret schematic wiring diagram of domestic refrigerator, household freezer, water dispenser, window type air conditioner, and split type air conditioner with 80-89% accuracy
- 3 Draw, read and interpret schematic wiring diagram of domestic refrigerator, household freezer, water dispenser, window type air conditioner, and split type air conditioner with 70-79% accuracy.
- 2 Draw, read and interpret schematic wiring diagram of domestic refrigerator, household freezer, water dispenser, window type air conditioner, and split type air conditioner with 65-69% accuracy.

- 1 Draw, read and interpret schematic wiring diagram of domestic refrigerator, household freezer, water dispenser, window type air conditioner, and split type air conditioner with below 65% accuracy.

E. Use air conditioning and refrigeration simulator to simulate electric motor problems commonly encountered in the field and apply the test procedures to troubleshoot repair the actual unit.

- 5 Simulate electric motor problem commonly encountered in the field and follow the test procedures to troubleshoot and repair the actual unit with 90-100% accuracy.
- 4 Simulate electrical problems commonly encountered in the field and follow the test procedures to troubleshoot and repair the actual unit with 80-89% accuracy.
- 3 Simulate electrical problems commonly encountered in the field and follow the test procedures to troubleshoot and repair the actual unit with 70-79% accuracy.
- 2 Simulate electrical problems commonly encountered in the field and follow the test procedures to troubleshoot and repair the actual unit with 65-69% accuracy.
- 1 Simulate electrical problems commonly encountered in the field and follow the test procedures to troubleshoot and repair the actual unit with below 65% accuracy.