

## Washtenaw Community College Comprehensive Report

### HVA 103 Heating, Ventilation and Air Conditioning II Effective Term: Spring/Summer 2025

#### Course Cover

**College:** Advanced Technologies and Public Service Careers  
**Division:** Advanced Technologies and Public Service Careers  
**Department:** Heating, Ventilation and A/C  
**Discipline:** Heating, Ventilation, Air Conditioning and Refrigeration  
**Course Number:** 103  
**Org Number:** 14750  
**Full Course Title:** Heating, Ventilation and Air Conditioning II  
**Transcript Title:** HVAC II  
**Is Consultation with other department(s) required:** No  
**Publish in the Following:** College Catalog , Time Schedule , Web Page  
**Reason for Submission:** Three Year Review / Assessment Report  
**Change Information:**

#### **Outcomes/Assessment**

**Rationale:** Outcomes and assessment plan need to be updated in order for meaningful assessment. Remove MTH 067 as a prerequisite (listed in the catalog) and add MTH 125X and 160/160X as options.  
**Proposed Start Semester:** Winter 2025  
**Course Description:** In this course, students will learn basic electrical theory as applied to heating, ventilation, air conditioning and refrigeration systems. Students solve electrical problems, construct and troubleshoot series-parallel circuits, identify and troubleshoot electrical components, apply alternating current principles, identify, test and troubleshoot motors and motor control circuits, and interpret electrical diagrams and use them to troubleshoot Heating, Ventilation, Air Conditioning and Refrigeration (HVACR) systems.

#### Course Credit Hours

**Variable hours:** No  
**Credits:** 4  
**Lecture Hours: Instructor: 60 Student: 60**  
**Lab: Instructor: 30 Student: 30**  
**Clinical: Instructor: 0 Student: 0**  
  
**Total Contact Hours: Instructor: 90 Student: 90**  
**Repeatable for Credit:** NO  
**Grading Methods:** Letter Grades  
Audit  
**Are lectures, labs, or clinicals offered as separate sections?:** NO (same sections)

#### College-Level Reading and Writing

College-level Reading & Writing

#### College-Level Math

No Level Required

**Requisites****Prerequisite**

Academic Math Level 2

or

**Prerequisite**

MTH 125; may enroll concurrently

or

**Prerequisite**

MTH 125X; may enroll concurrently

or

**Prerequisite**

MTH 160; may enroll concurrently

or

**Prerequisite**

MTH 160X; may enroll concurrently

**General Education****Request Course Transfer****Proposed For:****Student Learning Outcomes**

1. Solve electrical problems by applying the fundamental relationships between voltage, current, resistance and power.

**Assessment 1**

Assessment Tool: Outcome-related departmental final exam questions

Assessment Date: Winter 2027

Assessment Cycle: Every Three Years

Course section(s)/other population: All

Number students to be assessed: Random sample of 50% of all students from all sections.

How the assessment will be scored: Answer key

Standard of success to be used for this assessment: 70% of students will score 70% or higher on the outcome-related questions.

Who will score and analyze the data: Departmental faculty

2. Identify series, parallel, and series-parallel circuits and diagnose them.

**Assessment 1**

Assessment Tool: Outcome-related departmental final exam questions

Assessment Date: Winter 2027

Assessment Cycle: Every Three Years

Course section(s)/other population: All

Number students to be assessed: Random sample of 50% of all students from all sections.

How the assessment will be scored: Answer key

Standard of success to be used for this assessment: 70% of students will score 70% or higher on the outcome-related questions.

Who will score and analyze the data: Departmental faculty

3. Identify the operating principles of and diagnose electrical components in HVAC systems.

**Assessment 1**

Assessment Tool: Outcome-related departmental final exam questions

Assessment Date: Winter 2027

Assessment Cycle: Every Three Years

Course section(s)/other population: All

Number students to be assessed: Random sample of 50% of all students from all sections.

How the assessment will be scored: Answer key

Standard of success to be used for this assessment: 70% of students will score 70% or higher on the outcome-related questions.

Who will score and analyze the data: Departmental faculty

4. Apply alternating current principles to identify, test and diagnose system controls and components based on the system schematics.

#### **Assessment 1**

Assessment Tool: Practical lab portion of the departmental final exam

Assessment Date: Winter 2027

Assessment Cycle: Every Three Years

Course section(s)/other population: All

Number students to be assessed: Random sample of 50% of all students from all sections.

How the assessment will be scored: Answer key

Standard of success to be used for this assessment: 70% of students will score 70% or higher on the outcome-related questions.

Who will score and analyze the data: Departmental faculty

### **Course Objectives**

1. Identify electrical risks and safety guidelines.
2. Identify the properties of voltage, current and resistance in simple terms.
3. Identify the relationship between voltage, current and resistance (Ohm's Law).
4. Perform simple calculations involving voltage, current, resistance and power.
5. Identify the flow of electricity in a circuit.
6. Use a multimeter to measure voltage, current and resistance.
7. Identify the elements of a basic electric circuit: supply, conductor, control, and load.
8. Recognize the characteristics of series, parallel and series-parallel circuits.
9. Recognize the series and parallel circuits in HVAC applications.
10. Estimate current, voltage and resistance in simple series, parallel and series-parallel circuits.
11. Identify open circuits and short circuits in simple series, parallel and series-parallel circuits.
12. Wire simple series, parallel, and series-parallel circuits from a schematic diagram.
13. Use a multimeter to troubleshoot simple series, parallel and series-parallel circuits.
14. Recognize the operating principles of standard electrical components.
15. Identify and locate standard HVAC electrical components in the field and on schematic and connection diagrams.
16. Use a multimeter to test standard electrical components.
17. Recognize the schematics for simple HVACR systems.
18. Analyze the operation of simple HVAC circuits.
19. Identify the parts and terminals of a heating/cooling thermostat.
20. Recognize common electrical terms and principles: direct current (DC), alternating current (AC), frequency, peak voltage, effective root mean square (RMS) voltage, cycle, impedance, reactance, true power, apparent power, power factor, electromagnetic induction and electromagnetism.
21. Perform and interpret AC voltage and current measurements in a circuit.
22. Recognize the principles of operation of a run or start capacitor and their effect in a circuit.
23. Calculate impedance, given voltage and current.
24. Determine voltage step up/step down ratios and Volt-amps (VA) ratings of transformers.
25. Recognize common single and three-phase voltage systems in residential and commercial installations.
26. Determine wire size, resistance and voltage drop.
27. Wire standard 120 Vac electrical components using proper wiring techniques, tools and materials.
28. Use a multimeter to test a transformer.
29. Interpret the data on a motor nameplate.
30. Recognize the types, wiring and applications of split phase, shaded pole, capacitor start and permanent split-capacitor motors.

31. Identify motor related electrical components including: single and three-phase fused disconnect switches, motors, capacitors, contactors, motor starters, motor overloads, current and potential relays.
32. Identify the operating principles of and the construction features of a single-phase hermetic compressor.
33. Wire a single-phase multi-speed permanent split capacitor (PSC) motor.
34. Test and troubleshoot motors, motor-related electrical components and motor control circuits.
35. Troubleshoot problems with single phase compressors.
36. Draw a simplified wiring diagram for a residential gas furnace.
37. Draw a simplified wiring diagram for a residential air conditioning unit.
38. Develop a ladder diagram from a wiring diagram.
39. Read and interpret schematic and ladder diagrams.
40. List the probable cause of failure for any load in a gas furnace or split-system air conditioner, given the problem symptoms and a schematic diagram.
41. Use a systematic procedure to troubleshoot basic and intermediate-level electrical problems in a residential/small commercial air conditioning system.

## New Resources for Course

### Course Textbooks/Resources

#### Textbooks

Smith, Russell E. *Electricity for Refrigeration, Heating and Air Conditioning*, 11th ed. Cengage, 2019, ISBN: 9780357618707.

#### Manuals

Brock D. , Carter R.. Course Pack: HVA 103 9th Edition, WCC HVAC Department drb, 07-01-2021

#### Periodicals

#### Software

### Equipment/Facilities

Level III classroom

Computer workstations/lab

Data projector/computer

<u>Reviewer</u>	<u>Action</u>	<u>Date</u>
<b>Faculty Preparer:</b> <i>Robert Carter</i>	<i>Faculty Preparer</i>	<i>Jun 18, 2024</i>
<b>Department Chair/Area Director:</b> <i>Brian Martindale</i>	<i>Recommend Approval</i>	<i>Jun 21, 2024</i>
<b>Dean:</b> <i>Eva Samulski</i>	<i>Recommend Approval</i>	<i>Jun 27, 2024</i>
<b>Curriculum Committee Chair:</b> <i>Randy Van Wagnen</i>	<i>Recommend Approval</i>	<i>Jan 11, 2025</i>
<b>Assessment Committee Chair:</b> <i>Jessica Hale</i>	<i>Recommend Approval</i>	<i>Jan 22, 2025</i>
<b>Vice President for Instruction:</b> <i>Brandon Tucker</i>	<i>Approve</i>	<i>Jan 30, 2025</i>

## Washtenaw Community College Comprehensive Report

### HVA 103 Heating, Ventilation and Air Conditioning II Effective Term: Spring/Summer 2020

#### Course Cover

**Division:** Advanced Technologies and Public Service Careers  
**Department:** Heating, Ventilation and A/C  
**Discipline:** Heating, Ventilation, Air Conditioning and Refrigeration  
**Course Number:** 103  
**Org Number:** 14750  
**Full Course Title:** Heating, Ventilation and Air Conditioning II  
**Transcript Title:** HVAC II  
**Is Consultation with other department(s) required:** No  
**Publish in the Following:** College Catalog , Time Schedule , Web Page  
**Reason for Submission:** Three Year Review / Assessment Report  
**Change Information:**

**Consultation with all departments affected by this course is required.**

**Outcomes/Assessment**

**Objectives/Evaluation**

**Other:**

**Rationale:** Three-year update due

**Proposed Start Semester:** Winter 2020

**Course Description:** This course covers basic electrical theory as applied to heating, ventilation, air conditioning and refrigeration systems. Students solve electrical problems, construct and troubleshoot series-parallel circuits, identify and troubleshoot electrical components, apply alternating current principles, identify, test and troubleshoot motors and motor control circuits, and interpret electrical diagrams and use them to troubleshoot HVACR systems.

#### Course Credit Hours

**Variable hours:** No

**Credits:** 4

**Lecture Hours: Instructor: 60 Student: 60**

**Lab: Instructor: 30 Student: 30**

**Clinical: Instructor: 0 Student: 0**

**Total Contact Hours: Instructor: 90 Student: 90**

**Repeatable for Credit:** NO

**Grading Methods:** Letter Grades

Audit

**Are lectures, labs, or clinicals offered as separate sections?:** NO (same sections)

#### College-Level Reading and Writing

College-level Reading & Writing

#### College-Level Math

Level 2

#### Requisites

## **General Education**

### **Request Course Transfer**

#### **Proposed For:**

### **Student Learning Outcomes**

1. Solve electrical problems by applying the fundamental relationships between voltage, current, resistance and power.

#### **Assessment 1**

Assessment Tool: Departmental final exam

Assessment Date: Winter 2020

Assessment Cycle: Every Three Years

Course section(s)/other population: All

Number students to be assessed: Random sample of 50% of all students from all sections

How the assessment will be scored: Answer key

Standard of success to be used for this assessment: 70% of students will score 70% or higher on the outcome-related questions.

Who will score and analyze the data: Department faculty

2. Identify series, parallel and series-parallel circuits and diagnose them.

#### **Assessment 1**

Assessment Tool: Departmental final exam

Assessment Date: Winter 2020

Assessment Cycle: Every Three Years

Course section(s)/other population: All

Number students to be assessed: Random sample of 50% of all students from all sections

How the assessment will be scored: Answer key

Standard of success to be used for this assessment: 70% of students will score 70% or higher on the outcome-related questions.

Who will score and analyze the data: Departmental faculty

3. Identify the operating principles of and diagnose electrical components in HVAC systems.

#### **Assessment 1**

Assessment Tool: Departmental final exam

Assessment Date: Winter 2020

Assessment Cycle: Every Three Years

Course section(s)/other population: All

Number students to be assessed: Random sample of 50% of all students from all sections

How the assessment will be scored: Answer key

Standard of success to be used for this assessment: 70% of students will score 70% or higher on the outcome-related questions.

Who will score and analyze the data: Departmental faculty

4. Apply alternating current principles to the diagnosis and testing of HVAC systems.

#### **Assessment 1**

Assessment Tool: Practical lab portion of the departmental final exam

Assessment Date: Winter 2020

Assessment Cycle: Every Three Years

Course section(s)/other population: All

Number students to be assessed: Random sample of 50% of all students from all sections

How the assessment will be scored: Answer key

Standard of success to be used for this assessment: 70% of students will score 70% or higher on the outcome-related questions.

Who will score and analyze the data: Departmental faculty

5. Identify, test and diagnose motors and motor controls.

**Assessment 1**

Assessment Tool: Practical lab portion of the departmental final exam

Assessment Date: Winter 2020

Assessment Cycle: Every Three Years

Course section(s)/other population: All

Number students to be assessed: Random sample of 50% of all students from all sections

How the assessment will be scored: Answer key

Standard of success to be used for this assessment: 70% of students will score 70% or higher on the outcome-related questions.

Who will score and analyze the data: Departmental faculty

6. Interpret electrical diagrams and use them to diagnose HVAC systems.

**Assessment 1**

Assessment Tool: Practical lab portion of the departmental final exam

Assessment Date: Winter 2020

Assessment Cycle: Every Three Years

Course section(s)/other population: All

Number students to be assessed: Random sample of 50% of all students from all sections

How the assessment will be scored: Answer key

Standard of success to be used for this assessment: 70% of students will score 70% or higher on the outcome-related questions.

Who will score and analyze the data: Departmental faculty

**Course Objectives**

1. Identify electrical risks and safety guidelines.
2. Identify the properties of voltage, current and resistance in simple terms.
3. Identify the relationship between voltage, current and resistance (Ohm's Law).
4. Perform simple calculations involving voltage, current, resistance and power.
5. Identify the flow of electricity in a circuit.
6. Use a multimeter to measure voltage, current and resistance.
7. Identify the elements of a basic electric circuit: supply, conductor, control, load.
8. Recognize the characteristics of series, parallel and series-parallel circuits.
9. Recognize the series and parallel circuits in HVAC applications.
10. Estimate current, voltage and resistance in simple series, parallel and series-parallel circuits.
11. Identify open circuits and short circuits in simple series, parallel and series-parallel circuits.
12. Wire simple series, parallel and series-parallel circuits from a schematic diagram.
13. Use a multimeter to troubleshoot simple series, parallel and series-parallel circuits.
14. Recognize the operating principles of standard electrical components.
15. Identify and locate standard HVAC electrical components in the field and on schematic and connection diagrams.
16. Use a multimeter to test standard electrical components.
17. Recognize the schematics for simple HVACR systems.
18. Analyze the operation of simple HVAC circuits.
19. Identify the parts and terminals of a heating/cooling thermostat.
20. Recognize common electrical terms and principles: DC, AC, frequency, peak voltage, effective (rms) voltage, cycle, impedance, reactance, true power, apparent power, power factor, electromagnetic induction and electromagnetism.
21. Perform and interpret AC voltage and current measurements in a circuit.
22. Recognize the principles of operation of a run or start capacitor and their effect in a circuit.
23. Calculate impedance, given voltage and current.
24. Determine voltage step up/step down ratios and Volt-amperes (VA) ratings of transformers.

25. Recognize common single and three phase voltage systems in residential and commercial installations.
26. Determine wire size, resistance and voltage drop.
27. Wire standard 120 Vac electrical components using proper wiring techniques, tools and materials.
28. Use a multimeter to test a transformer.
29. Interpret the data on a motor nameplate.
30. Recognize the types, wiring and applications of split phase, shaded pole, capacitor start and permanent split-capacitor motors.
31. Identify motor related electrical components including: single and three phase fused disconnect switches, motors, capacitors, contactors, motor starters, motor overloads, current and potential relays.
32. Identify the operating principles of and the construction features of a single phase hermetic compressor.
33. Wire a single phase multi-speed permanent split capacitor (PSC) motor.
34. Test and troubleshoot motors, motor-related electrical components and motor control circuits.
35. Troubleshoot problems with single phase compressors.
36. Draw a simplified wiring diagram for a residential gas furnace.
37. Draw a simplified wiring diagram for a residential air conditioning unit.
38. Develop a ladder diagram from a wiring diagram.
39. Read and interpret schematic and ladder diagrams.
40. List the probable cause of failure for any load in a gas furnace or split system air conditioner, given the problem symptoms and a schematic diagram.
41. Use a systematic procedure to troubleshoot basic and intermediate level electrical problems in a residential/small commercial air conditioning system.

## New Resources for Course

### Course Textbooks/Resources

#### Textbooks

Smith, Russell E. *Electricity for Refrigeration, Heating and Air Conditioning*, Tenth ed. Cengage, 2019, ISBN: 9781337399128.

#### Manuals

Brock D. , Carter R.. Course Pack: HVA 103 5th Edition, WCC HVAC Department drb, 07-01-2019

#### Periodicals

#### Software

### Equipment/Facilities

Level III classroom

Computer workstations/lab

Data projector/computer

### Reviewer

#### **Faculty Preparer:**

*Robert Carter*

### Action

*Faculty Preparer*

### Date

*Aug 08, 2019*

#### **Department Chair/Area Director:**

*Brian Martindale*

*Recommend Approval*

*Aug 28, 2019*

#### **Dean:**

*Brandon Tucker*

*Recommend Approval*

*Aug 29, 2019*

#### **Curriculum Committee Chair:**

*Lisa Veasey*

*Recommend Approval*

*Dec 04, 2019*

#### **Assessment Committee Chair:**

*Shawn Deron*

*Recommend Approval*

*Dec 17, 2019*



**Vice President for Instruction:**

*Kimberly Hurns*

*Approve*

*Dec 18, 2019*

# Washtenaw Community College Comprehensive Report

## HVA 103 Heating, Ventilation and Air Conditioning II Effective Term: Spring/Summer 2017

### Course Cover

**Division:** Advanced Technologies and Public Service Careers

**Department:** Heating, Ventilation and A/C

**Discipline:** Heating, Ventilation, Air Conditioning and Refrigeration

**Course Number:** 103

**Org Number:** 14750

**Full Course Title:** Heating, Ventilation and Air Conditioning II

**Transcript Title:** HVAC II

**Is Consultation with other department(s) required:** No

**Publish in the Following:** College Catalog , Time Schedule , Web Page

**Reason for Submission:** Three Year Review / Assessment Report

**Change Information:**

**Consultation with all departments affected by this course is required.**

**Pre-requisite, co-requisite, or enrollment restrictions**

**Outcomes/Assessment**

**Rationale:** Three year syllabus review

**Proposed Start Semester:** Spring/Summer 2017

**Course Description:** This course covers basic electrical theory as applied to heating, ventilation, air conditioning and refrigeration systems. Students solve electrical problems, construct and troubleshoot series-parallel circuits, identify and troubleshoot electrical components, apply alternating current principles, identify, test and troubleshoot motors and motor control circuits, and interpret electrical diagrams and use them to troubleshoot HVACR systems.

### Course Credit Hours

**Variable hours:** No

**Credits:** 4

**Lecture Hours: Instructor:** 60 **Student:** 60

**Lab: Instructor:** 30 **Student:** 30

**Clinical: Instructor:** 0 **Student:** 0

**Total Contact Hours: Instructor:** 90 **Student:** 90

**Repeatable for Credit:** NO

**Grading Methods:** Letter Grades

Audit

**Are lectures, labs, or clinicals offered as separate sections?:** NO (same sections)

### College-Level Reading and Writing

College-level Reading & Writing

### College-Level Math

Level 2

### Requisites

## **General Education**

### **Request Course Transfer**

**Proposed For:**

### **Student Learning Outcomes**

1. Solve electrical problems by applying the fundamental relationships between voltage, current, resistance and power.

**Assessment 1**

**Assessment Tool:** A departmental final exam will be used to assess understanding of key concepts

**Assessment Date:** Winter 2018

**Assessment Cycle:** Every Three Years

**Course section(s)/other population:** 2 sections

**Number students to be assessed:** Random 24-48 students

**How the assessment will be scored:** Answer key

**Standard of success to be used for this assessment:** Minimum of 70% of students achieve a score of 70% or higher

**Who will score and analyze the data:** Department Faculty

2. Identify series, parallel and series-parallel circuits and troubleshoot them.

**Assessment 1**

**Assessment Tool:** A departmental final exam will be used to assess understanding of key concepts

**Assessment Date:** Winter 2018

**Assessment Cycle:** Every Three Years

**Course section(s)/other population:** 2 sections

**Number students to be assessed:** Random 24 to 48 students

**How the assessment will be scored:** Answer key

**Standard of success to be used for this assessment:** Minimum of 70% of students achieve a score of 70% or higher

**Who will score and analyze the data:** Departmental faculty

3. Identify the operating principles of and troubleshoot electrical components in HVAC systems.

**Assessment 1**

**Assessment Tool:** A departmental final exam will be used to assess understanding of key concepts

**Assessment Date:** Winter 2018

**Assessment Cycle:** Every Three Years

**Course section(s)/other population:** 2 sections

**Number students to be assessed:** Random 24 to 48 students

How the assessment will be scored: Answer key

Standard of success to be used for this assessment: Minimum of 70% of students achieve a score of 70% or higher

Who will score and analyze the data: Departmental faculty

4. Apply alternating current principles to the installation and testing of HVAC systems.

**Assessment 1**

Assessment Tool: A departmental final exam will be used to assess understanding of key concepts

Assessment Date: Winter 2018

Assessment Cycle: Every Three Years

Course section(s)/other population: 2 sections

Number students to be assessed: Random 24 to 48 students

How the assessment will be scored: Answer key

Standard of success to be used for this assessment: Minimum of 70% of students achieve a score of 70% or higher

Who will score and analyze the data: Departmental faculty

5. Identify, test and troubleshoot motors and motor controls.

**Assessment 1**

Assessment Tool: A departmental final exam will be used to assess understanding of key concepts

Assessment Date: Winter 2018

Assessment Cycle: Every Three Years

Course section(s)/other population: 2 sections

Number students to be assessed: Random 24 to 48 students

How the assessment will be scored: Answer key

Standard of success to be used for this assessment: Minimum of 70% students achieve a score of 70% or higher

Who will score and analyze the data: Departmental faculty

6. Interpret electrical diagrams and use them to troubleshoot HVAC systems.

**Assessment 1**

Assessment Tool: A departmental final exam will be used to assess proficiency in applying the concepts and in performing hands-on tasks

Assessment Date: Winter 2018

Assessment Cycle: Every Three Years

Course section(s)/other population: 2 sections

Number students to be assessed: Random 24 to 48 students

How the assessment will be scored: Answer key

Standard of success to be used for this assessment: Minimum of 70% of students achieve a score of 70% or higher

Who will score and analyze the data: Departmental faculty

## **Course Objectives**

1. Identify electrical risks and safety guidelines.
2. Identify the properties of voltage, current and resistance in simple terms.
3. Identify the relationship between voltage, current and resistance (Ohm's Law).
4. Perform simple calculations involving voltage, current, resistance and power.
5. Identify the flow of electricity in a circuit.
6. Use a multimeter to measure voltage, current and resistance.
7. Identify the elements of a basic electric circuit: supply, conductor, control, load.
8. Recognize the characteristics of series, parallel and series-parallel circuits.
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10. Estimate current, voltage and resistance in simple series, parallel and series-parallel circuits.
11. Identify open circuits and short circuits in simple series, parallel and series-parallel circuits.
12. Wire simple series, parallel and series-parallel circuits from a schematic diagram.
13. Use a multimeter to troubleshoot simple series, parallel and series-parallel circuits.
14. Recognize the operating principles of standard electrical components.
15. Identify and locate standard HVAC electrical components in the field and on schematic and connection diagrams.
16. Use a multimeter to test standard electrical components.
17. Recognize the schematics for simple HVACR systems.
18. Analyze the operation of simple HVAC circuits.
19. Identify the parts and terminals of a heating/cooling thermostat.
20. Recognize common electrical terms and principles: DC, AC, frequency, peak voltage, effective (rms) voltage, cycle, sine wave, phase shift, impedance, reactance, true power, apparent power, power factor, electromagnetic induction and electromagnetism.
21. Perform and interpret AC voltage and current measurements in a circuit.
22. Recognize the principles of operation of capacitors and inductors and their effect in a circuit.
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24. Determine voltage step up/step down ratios and VA ratings of transformers.
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26. Determine wire size, resistance and voltage drop.
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29. Interpret the data on a motor nameplate.
30. Recognize the types, wiring and applications of split phase, shaded pole, capacitor start and permanent split-capacitor motors.
31. Identify motor related electrical components including: single and three phase fused disconnect switches, motors, capacitors, contactors, motor starters, motor overloads, current and potential relays.
32. Identify the operating principles of and the construction features of a single phase hermetic compressor.
33. Wire a single phase multi-speed PSC motor.
34. Test and troubleshoot motors, motor-related electrical components and motor control circuits.

35. Troubleshoot problems with single phase compressors.
36. Draw a simplified wiring diagram for a residential gas furnace.
37. Draw a simplified wiring diagram for a residential air conditioning unit.
38. Develop a ladder diagram from a wiring diagram.
39. Read and interpret schematic and ladder diagrams.
40. List the probable cause of failure for any load in a gas furnace or split system air conditioner, given the problem symptoms and a schematic diagram.
41. Use a systematic procedure to troubleshoot basic and intermediate level electrical problems in a residential/small commercial air conditioning system.

### New Resources for Course

#### Course Textbooks/Resources

##### Textbooks

Smith, Russell E. *Electricity fo Refrigeration, Heating and Air Conditioning*, Ninth ed. Cengage, 2014, ISBN: 9781285179988.

##### Manuals

Petty,Dale. Course Pack: HVA 103 2.4., Washtenaw, 01-01-2015

##### Periodicals

##### Software

#### Equipment/Facilities

Level III classroom

Computer workstations/lab

Data projector/computer

#### Reviewer

#### Action

#### Date

#### **Faculty Preparer:**

*Robert Carter*

*Faculty Preparer*

*Sep 28, 2016*

#### **Department Chair/Area Director:**

*Robert Carter*

*Recommend Approval*

*Sep 29, 2016*

#### **Dean:**

*Brandon Tucker*

*Recommend Approval*

*Oct 03, 2016*

#### **Curriculum Committee Chair:**

*David Wooten*

*Recommend Approval*

*Nov 07, 2016*

#### **Assessment Committee Chair:**

*Michelle Garey*

*Recommend Approval*

*Nov 07, 2016*

#### **Vice President for Instruction:**

*Bill Abernethy*

*Approve*

*Nov 09, 2016*