



## HVA 103: Heating Ventilation and Air Conditioning II – Winter 2013

CRN 10954 / Section 02

MW 5:00 pm – 8:00 pm (OE 101/109/105)

---

**Instructor:** Dale Petty

**Phone/VoiceMail:** 734.677.5108

**Email:** petty@wccnet.edu

**Websites:** <https://blackboard.wccnet.edu/> <http://courses.wccnet.edu/~petty/>

**Office:** TI 122C

**Office Hours:** Appointment suggested. Schedule posted in TI 122 and at <http://www4.wccnet.edu/search/officehours/pdf/officehours.pdf>  
Please email me if you'd like to meet at some other time.

**Level 1 Prereq:** Academic Reading and Writing Levels of 6; Academic Math Level 2  
HVA 101 prior or concurrent is recommended.

**Materials:** Electricity for Refrigeration, Heating and Air Conditioning, 8<sup>th</sup> Edition,  
Russell E. Smith  
Coursepack: HVA 103, Version 2.4, © 2007 Dale Petty  
Safety glasses

3-Ring binder (for Lab Manual and other materials)  
Calculator

**Format:** We will spend about four hours per week in lecture/discussion and two hours per week in lab.

**Homework:** You should expect to spend at least 8 hours per week reading, working problems, preparing for lab, discussing with classmates and studying for exams. I recommend that you do a quick overview of the reading assignment before the lecture and a thorough reading following the lecture. Homework problems should be done following the lecture and before the next class so that you arrive prepared to share questions and ideas. Homework will be discussed in class, but will not be collected.

**Labs:** Please follow appropriate safety practices in the lab!  
Safety glasses must be worn in the lab.

Lab prep should be done as much as possible before you come to class.  
Labs will mostly be done individually, but you are encouraged to consult with classmates as you work on the lab. When working with a partner, please share the work equally to give both of you an opportunity to learn.

Before turning in a lab, please verify that you have answered all questions, and discuss any remaining questions you still have with a classmate. Finally, review your lab with your instructor. Labs will be graded on completeness and correctness.

It may be possible to schedule a time to make up or complete a lab. Please check with your instructor. There is a 1 point penalty for labs turned in more than a week after they are assigned.

**Quizzes/Exams:** There will be regular quizzes (written and practical) and a comprehensive Final Exam. You may use a calculator (not a cell phone) and one 3 x 5" crib sheet (both sides) unless otherwise noted. You must turn in your crib sheet with your Final Exam.

Quizzes missed may not be made up, however the grade for any missed quizzes will be raised to match your final exam grade percentage.

**Grading:** Your final grade will be based on the total number of points accumulated during the semester as follows:

Labs & Special Assignments (3 pts each)	~ 15 % of your grade
Quizzes	~ 55 % of your grade
Final Exam	~ 30 % of your grade

Letter grades will be assigned according to the following scale.

A	93 - 100 %	C	73 - 76 %
A-	90 - 92 %	C-	70 - 72 %
B+	87 - 89 %	D+	67 - 69 %
B	83 - 86 %	D	63 - 66 %
B-	80 - 82 %	D-	60 - 62 %
C+	77 - 79 %	F	0 - 59 %

W Withdrew from class by submitting a drop form to Student Records

I An incomplete may be given in the event of extreme circumstances near the end of the semester when only a few assignments remain to be completed

**Support:** Extra help is available from your instructor after class, during office hours or by appointment.

*Learning Support Services* provides tutoring for all enrolled students.

If you need an academic accommodation because of a disability, please make an appointment with Learning Support Services as soon as possible to verify the disability and arrange accommodations. 734/ 973-3342, LA 104

## **HVA 103 OBJECTIVES**

- 1. Solve electrical problems by applying the fundamental relationships between voltage, current, resistance and power.**
  - 1.1. Identify electrical risks and safety guidelines
  - 1.2. Identify the properties of voltage, current and resistance in simple terms
  - 1.3. Identify the relationship between voltage, current and resistance (Ohm's Law)
  - 1.4. Perform simple calculations involving voltage, current, resistance and power
  - 1.5. Identify the flow of electricity in a circuit
  - 1.6. Use a multimeter to measure voltage, current and resistance
  
- 2. Recognize series, parallel and series-parallel circuits and troubleshoot them.**
  - 2.1. Identify the elements of a basic electric circuit: supply, conductor, control, load
  - 2.2. Recognize the characteristics of series, parallel and series-parallel circuits
  - 2.3. Recognize series and parallel circuits in HVAC applications
  - 2.4. Estimate current, voltage and resistance in simple series, parallel and series-parallel circuits
  - 2.5. Identify open circuits and short circuits in simple series, parallel and series-parallel circuits
  - 2.6. Wire simple series, parallel and series-parallel circuits from a schematic diagram
  - 2.7. Use a multimeter to troubleshoot simple series, parallel and series-parallel circuits
  
- 3. Identify the operating principles of, and troubleshoot electrical components in HVAC systems.**
  - 3.1. Recognize the operating principles of standard electrical components.
  - 3.2. Identify and locate standard HVAC electrical components in the field and on schematic and connection diagrams.
  - 3.3. Use a multimeter to test standard electrical components.
  - 3.4. Recognize the schematics for simple HVACR systems.
  - 3.5. Analyze the operation of simple HVAC circuits.
  - 3.6. Identify the parts and terminals of a heating/cooling thermostat
  - 3.7. Install, test and troubleshoot heating and cooling thermostats
  
- 4. Apply alternating current principles to the installation and testing of HVAC systems.**
  - 4.1. 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.
  - 4.2. Perform and interpret AC voltage and current measurements in a circuit
  - 4.3. Recognize the principles of operation of capacitors and inductors and their effect in a circuit.
  - 4.4. Calculate impedance, given voltage and current
  - 4.5. Determine voltage step up/step down ratios and VA ratings of transformers
  - 4.6. Recognize common single and three phase voltage systems in residential and commercial installations
  - 4.7. Determine wire size, resistance and voltage drop.
  - 4.8. Wire standard 120 Vac electrical components using proper wiring techniques, tools and materials
  - 4.9. Use a multimeter to test a transformer

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

- 5.1. Interpret the data on a motor nameplate.
- 5.2. Recognize the types, wiring and applications of split phase, shaded pole, capacitor start and permanent split-capacitor motors
- 5.3. Identify motor related electrical components including: single and three phase fused disconnect switches, motors, capacitors, contactors, motor starters, motor overloads, current and potential relays
- 5.4. Identify the operating principles of, and the construction features of a single phase hermetic compressor
- 5.5. Wire a single phase multi-speed PSC motor
- 5.6. Test and troubleshoot motors, motor related electrical components and motor control circuits
- 5.7. Troubleshoot problems with single phase compressors

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

- 6.1. Draw a simplified wiring diagram for a residential gas furnace
- 6.2. Draw a simplified wiring diagram for a residential air conditioning unit
- 6.3. Develop a ladder diagram from a wiring diagram
- 6.4. Read and interpret schematic and ladder diagrams
- 6.5. 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.
- 6.6. Use a systematic procedure to troubleshoot basic and intermediate level electrical problems in a residential/small commercial air conditioning system

## **Washtenaw Community College Board of Trustees Policies**

### **4095 -- STUDENT RIGHTS AND RESPONSIBILITIES**

#### **Academic Dishonesty**

All forms of academic dishonesty including but not limited to collusion, fabrication, cheating, and plagiarism will call for discipline.

1. Collusion is defined as the unauthorized collaboration with any other person in preparing work offered for individual credit.
  2. Fabrication is defined as intentionally falsifying or inventing any information or citation on any academic exercise.
  3. Cheating is defined as intentionally using or attempting to use unauthorized materials, information, or study aids in any academic exercise.
  4. Plagiarism is defined as the appropriation of any other person's work and the unacknowledged incorporation of that work in one's own work offered for credit.
-

## HVA 103 Heating, Ventilation and Air Conditioning II – Winter 2013 Course Outline (tentative)

Instructor: Dale Petty email: [petty@wccnet.edu](mailto:petty@wccnet.edu) phone: 734-677-5108

Class	Date	Lecture Topics	Homework: Reading	Homework: Problems (due for next class)	Labs
1	1/14	Course Overview; electrical safety, electrical grounding, wiring circuits from schematics	Smith Ch 1	Ch* 1: 1-20 Blackboard Assignment #1	Lab 1: Wiring Circuits from Schematics
2	1/16	Voltage, resistance and current; units and calculations; meters and electrical measurements; prefixes  <b>No Class 1/21 – Celebrate MLK Day!</b>	Smith Ch 2, Ch 4 CP pp. 3-4	Ch 2: 8-16, 22-35	Lab 2: Electrical Measurements: Resistance and Voltage
3	1/23	Current Measurements  Review	Smith Ch 4	Ch 4: 5- 8, 10-15, 17-20	Lab 3: Electrical Measurements: Current
4	1/28	Written Quiz 1			Practical Quiz 1
5	1/30	Series circuits: concepts, diagrams, wiring, measurements, troubleshooting	Smith Ch 3	Ch 3: 1-11, 24, 25 CP* pp. 5-10	Lab 4: Series Circuit Measurements and Troubleshooting – Part 1
6	2/4	Series circuit troubleshooting continued	Smith Ch 3	CP pp. 11-16	Lab 5: Series Circuit Measurements and Troubleshooting – Part 2
7	2/6	Parallel circuits: concepts, diagrams, wiring, measurements, troubleshooting	Smith Ch 3	Ch 3: 12-17, 21-23	Lab 6: Parallel Circuit Measurements and Troubleshooting
8	2/11	Series Parallel Circuits: concepts, diagrams, wiring, measurements, troubleshooting	Smith Ch 3	Ch 3: 18-20; CP pp. 25-31, # 1.-14.	Lab 7: Series-Parallel Circuit Measurements and Troubleshooting

Class	Date	Lecture Topics	Homework: Reading	Homework: Problems (due for next class)	Labs
9	2/13	Review	CP pp. 23-24	Quiz 2 Review	Lab 7 continued
10	2/18	Electrical components: identification, symbols, operation, troubleshooting  Written Quiz 2	Smith Ch 5	Ch 5: 1-30	
11	2/20	Practical Quiz 2 (check time & room!)			Lab 8: Components, Symbols and Diagrams (check time & room!)
12	2/25	Schematic and connection diagrams; simplified schematics for HVAC equipment (check time & room!)	Smith Ch 6	Ch 6: 1-20	Lab 8 continued (check time & room!)
13	2/27	Advanced schematics Convert between ladder and wiring diagrams Draw simple gas furnace and A/C diagrams  <b>No class 3 /4 and 3 /6 – winter break!</b>		Ch 6: 21-32 CP pp. 33-36	Lab 9: Reading Schematic Diagrams
14	3/11	Hampden Air Conditioning Control System (ACCS) – Operation and Troubleshooting	Hampden ACCS Student Manual	CP pp. 38, 40	Lab 10: Basic Electrical Troubleshooting on the ACCS - Level 1A
15	3/13	Review Drawing schematics and wiring diagrams continued.		Quiz 3 Review	Lab 11: Basic Electrical Troubleshooting on the ACCS - Level 1B
16	3/18	Written Quiz 3 (check time & room!)			Practical Quiz 3 (check time & room!)
17	3/20	Alternating Current terminology and concepts, electromagnetism, induction, capacitance, impedance; single and three phase transformers	Smith Ch 7	Ch 7: 1-11	Lab 12 AC Measurements and Wiring – Part 1

Class	Date	Lecture Topics	Homework: Reading	Homework: Problems (due for next class)	Labs
18	3/25	Alternating Current continued Single and three phase voltage systems		Ch 7: 12-25	Lab 12 Continued Lab 13A Component Testing
19	3/27	Sizing wire, voltage drop, disconnect switches, breaker panels, residential wiring	Smith Ch 8	Ch 8: 1-30	Lab 13 AC Measurements and Wiring – Part 2
20	4/1	Review Drawing schematics and wiring diagrams continued.			Lab 13 continued
21	4/3	Written Quiz 4			Practical Quiz 4
22	4/8	Electric motor concepts, construction, types, characteristics and troubleshooting; motor nameplates; single and three phase motors, hermetic compressors; wiring motors, motor capacitors	Smith Ch 9	Ch 9: 1-50; Practice Service Calls 1-6	Lab 14: Single Phase Motors
23	4/10	Electric motors continued	CP pg. 41	CP pp. 43-44	Lab 14 continued Optional: 14a – Motor Insulation Resistance Testing
24	4/15	Motor starting relays: current and potential; solid state relays; troubleshooting relays; motor bearings; using a “Megger” (check time & room!)	Smith Ch 10	Ch 10: 1-34 Practice Service Calls 1-6	Lab 15: Residential Furnace Motors and Controls (check time & room!)
25	4/17	Motor starters, contactors, and relays: identifying, characteristics, troubleshooting; overloads, service calls (check time & room!)	Smith Ch 11	Ch 11: 1-34 Practice Service Calls 1-5	Lab 16: Residential Air Conditioner Motors and Controls (check time & room!)
26	4/22	ACCS Troubleshooting Review	CP pg. 45		Lab 18: Basic Electrical Troubleshooting on the ACCS - Level 2A

Class	Date	Lecture Topics	Homework: Reading	Homework: Problems (due for next class)	Labs
27	4/24	Written Quiz 5 (check time & room!)			Practical Quiz 5 (check time & room!)
28	4/29	Thermostats: identify parts and terminals, describe the operation; wiring, anticipator adjustment, troubleshooting; Pressure switches	Smith Ch 12	Ch 12: 1-40 Practice Service Calls 1-5	Lab 17: Thermostats
29	5/1	Troubleshooting motors, contactors, relays, overloads, thermostats, pressure switches and transformers  Review for Final Exam	Smith Ch 15.1 -15.7	Ch 15: 1-25	Lab 19: Basic Electrical Troubleshooting on the ACCS - Level 2B
30	5/6	Final exam – written and practical  (must turn in crib sheet with exam!)			

\* “Ch” refers to a chapter in the textbook by R. Smith. “CP” refers to the Course Pack by D. Petty.