COURSE OUTLINE

ACHP172 – HEATING AND PLUMBING PRINCIPLES AND PRACTICES 2

Prepared By: MARTIN CLARK-STONE

SCHOOL OF ENGINEERING TECHNOLOGY

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A. **TITLE:** Heating and Plumbing Principles and Practices 2

B. **COURSE NUMBER:** ACHP172

C. **CREDIT HOURS:** 8

D. **WRITING INTENSIVE COURSE:** (OPTIONAL) No

E. **LENGTH OF COURSE:** 15 weeks (including final)

F. **SEMESTER(S) OFFERED:** Spring

G. **HOURS OF LECTURE:** 5 hrs. of lecture per week.
                          9 hrs. of lab per week.

H. **CATALOGUE DESCRIPTION:** Gas burner boiler installations with zoning; furnace installation and service; bathroom and kitchen plumbing installation; sheet metal layout and fabrication; heat loss and gain calculations; electrical schematics, controls, troubleshooting; duct sizing and installation.

I. **PRE-REQUISITES:** ACHP171
   **CO-COURSES:** Math101, CONS151

J. **STUDENT LEARNING OUTCOMES:**

   By the end of the course, the student should be able to:

<table>
<thead>
<tr>
<th>Course Objective</th>
<th>Institutional SLO</th>
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<tbody>
<tr>
<td>Install multiple zone hydronic heating systems using circulators or zone valves</td>
<td>3. Professional competence</td>
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<tr>
<td>in a group setting</td>
<td>4. Inter/Intra personal skills</td>
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<tr>
<td>Calculate heat loss and gain for residential and commercial buildings</td>
<td>3. Professional competence</td>
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<tr>
<td>Calculate boiler, furnace, pipe, duct, pump, fan, register and fin tube size</td>
<td>3. Professional competence</td>
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<td>for given heat losses within a group</td>
<td>4. Inter/Intra personal skills</td>
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<tr>
<td>Perform combustion efficiency and troubleshooting tests on a variety of heating</td>
<td>3. Professional competence</td>
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<tr>
<td>equipment</td>
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K. **TEXTBOOK:** Same as ACHP171, plus Manual J and Manual D by ACCA.
L. REFERENCES: Manufacturer installation and service manuals, ASHRAE Fundamentals.

M. EQUIPMENT: Various heating and plumbing equipment, combustion analyzer, velometer, multimeter, ammeter and monometer.

N. GRADING METHOD: (P/F, A-F, etc.): A-F.

O. MEASUREMENT CRITERIA/METHODS: One half of grade will come from completed lab projects. One half of grade will come from lecture quizzes and design project.

P. DETAILED TOPICAL OUTLINE:

1. Testing and inspecting plumbing systems
   a. Perform air pressure test on fabricated piping system;
   b. Diagnostic check of existing fixtures;
   c. Checking volume flow of existing system.

2. Replacing fixtures
   Diagnostic check of existing fixture reliability;
   d. Understanding and applying manufacturer data sheets for fixture replacement;
   e. Job cost estimating.

3. Water heater installation and service
   f. Calculating hot water demand;
   g. Sizing of gas, oil or electrical supply lines;
   h. Determining flue connections as required;
   i. Use of multimeter and manufacturer wiring diagrams for troubleshooting.

4. Sheet metal pattern drafting and fabrication
   j. Parallel line development pattern drafting including tees and wyes;
   k. Triangulation pattern drafting, including round to square transitions;
   l. Radial line development pattern drafting, including transitions with a miter;
   m. Fabrication of one of each of the above.

5. Gas fired equipment controls
   n. Zone valve control theory;
   o. Multiple circulator control relay;
   p. Hot surface ignition relay;
   q. Fan control and aquastat.

6. Hydronic system design
   r. Boiler selection, including piping and pick-up losses;
   s. Fuel and flue sizing;
   t. Supply and return piping sizing for multiple piping arrangements;
u. Valve, pump and accessory selection;

7. Heat loss and heat gain calculations
   w. Determining net wall area;
   x. Defining “u” value and htm value;
   y. Utilize published weather data charts to find temperature differences;
   z. Follow published format for room by room and building heat loss and gain.

8. Baseboard design
   aa. Apply manufacturer rating sheets for baseboard output;
   bb. Select proper length baseboard to match room heat loss;
   cc. Select differing types of baseboard to match application.

9. Duct design
   dd. Follow Manual J procedure for duct design;
   ee. Define pressure losses throughout duct system;
   ff. Select registers and grilles from manufacturer data.

10. Basic electrical theory
    gg. Define and apply Ohm’s law;
    hh. Apply theory to practical control applications;
    ii. Apply theory to wire sizing applications.

11. Use of multimeters for troubleshooting
    jj. Utilize meters for system testing;
    kk. Describe proper control sequence;
    ll. Observe operating conditions and compare to “b”;
    mm. Describe what part of system is not operating as designed.

12. Schematic diagram comprehension
    a. Describe basic schematic theory;
    b. Convert wiring diagram to schematic format;
    c. Trace and describe system operation.

Q. **LABORATORY OUTLINE:**
   1. Design and install a 3-piece bathroom (tub, toilet, lavatory)
   2. Design and install a multizone gas boiler system, using either zone valves or circulators.
   3. Install an oil, gas or electric water heater.
   4. Pre-job estimate and job cost out for above 3 installations.
   5. Combustion testing and troubleshooting on 3 lab units.
   6. Electrical testing and multimeter usage on lab breadboards.
7. Design and install bathroom and kitchen plumbing system for house built by Construction curriculum.
8. Sheet metal pattern drafting and fabrication, using parallel line development, triangulation and radial line development.
9. Testing and inspecting plumbing systems;
10. Replacing fixtures;
11. Water heater installation and service;
12. Sheet metal pattern drafting and fabrication;
13. Gas fired equipment controls;
14. Hydronic system design;
15. Heat loss and heat gain calculations;
16. Baseboard design;
17. Duct design;
18. Basic electrical theory;
19. Use of multimeters for troubleshooting;
20. Schematic diagram comprehension.