# DEPARTMENT OF POWER ENGINEERING

## COURSE OUTLINE – WINTER 2012

## POF 431 HEATING SYSTEMS, CONTROLS AND PLANT SERVICES – 1.5(28)


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**OFFICE HOURS:** As posted

### PREREQUISITE(S)/COREQUISITE:

### REQUIRED TEXT/RESOURCE MATERIALS:

**PE4B TEXT (BOOK 1 & 2)**
**PE4B WORKBOOK (1 & 2)**

### CALENDAR DESCRIPTION:

This course covers: heating boilers combustion and control systems; boiler fittings required, operation and location; types of heating systems including start up, shut down, cleaning, operation and maintenance; controls and control systems for heating boilers and systems; lighting systems, lighting controls, maintenance and energy conservation strategies; domestic systems cold water and hot water distribution systems, hot water heaters; and sanitary drainage systems, storm water drainage, sanitary drainage system maintenance.

### CREDIT/CONTACT HOURS:

1.5 CREDITS, 24 HOURS

### DELIVERY MODE(S):

Theory and Lab

### OBJECTIVES (OPTIONAL):

**UNIT 22 STEAM AND HOT WATER HEATING SYSTEMS**

Chapter 101(33): Steam Heating Equipment

Describe the operating principles of steam heating equipment and components.

1. Describe the construction and operation of steam heating system devices used to transfer heat from the steam to a heated space.
2. List and describe the auxiliary equipment used in a steam heating system, including air vents, radiator valves and traps, and condensate return equipment.

Chapter 102(34): Steam Heating Systems

Describe the operating principles and maintenance procedures of steam heating systems and the components of these systems.

1. Describe the standard types of piping and equipment layout for steam heating systems.
2. Describe the general operation and maintenance of steam heating systems.
3. Apply a steam heating system troubleshooting guide.

Chapter 103(35): Hot Water Heating Systems

Describe the various designs of hot water heating systems.

1. Sketch and describe the standard piping and circulation layouts of hot water heating systems.
2. Compare the advantages and disadvantages of hot water and steam heating systems.
3. Describe radiant panel and snow melting hot water systems.

Chapter 104(36): Hot Water Heating System Equipment and Operation

Describe accessories operation and trouble shooting of a hot water heating system.

1. Describe the purpose and function of standard hot water heating system accessories.
2. Explain how the locations of the hot water circulating pump and expansion tank are determined.
3. Describe the cleaning, filling, starting, routine operation and troubleshooting of hot water heating systems.
4. Apply a hot water heating system troubleshooting guide.

Chapter 105(37): Warm Air Heating System Equipment

Describe the operating principles of warm air heating sources.

1. Compare the advantages and disadvantages of forced and gravity warm air systems.
2. List and describe the common sources of warm air heat.
3. List and describe the operational characteristics of directly fired space heaters.

Chapter 106(38): Warm Air Furnace Components and Maintenance

Describe the components and maintenance requirements of typical warm air heating and ventilating systems.

1. Describe the operation of furnace components, including both mechanical and electronic filters.
2. Describe and discuss the relative merits of three types of air distribution and duct systems.
3. Describe the recommended maintenance procedures for warm air heating and ventilating systems.
4. Apply a troubleshooting guide for forced warm air systems and components.

Chapter 107(39): Ventilation and Air Filters

Describe the various ventilation systems found in buildings, as well as describe the various types of air filters used in these systems.

1. Explain the difference between natural and mechanical ventilation.
2. Describe the types of contaminants found in air.
3. Describe the types of air cleaning devices used in buildings.

Chapter 108(40): Infrared and Electric Heating

Describe infrared and electric heating systems.

1. Discuss the concept and application of infrared heating.
2. Describe the construction and operation of gas-fired and electric infrared heaters.
3. List the advantages of electric heating systems compared to other types of heating systems.

4. Describe the different methods of electric heating.

**UNIT 23 HEATING BOILER AND SYSTEM CONTROLS**

Chapter 109(41): Heating Boiler Feedwater Controls

Describe the various feedwater control methods and devices used in low-pressure steam boilers.

1. Describe the operation of a feedwater float switch operating a valve and float switch operating a pump.
2. Describe how condensate is collected and returned to the boiler.
3. Explain the purpose and function of heating boiler feedwater and condensate piping connections.

Chapter 110(42): Heating Boiler Operating Controls

Name and describe the various operating controls found on low-pressure heating boilers.

1. Describe the operation of the on-off control, the high-low fire control, the modulating control and the high limit control found on low-pressure steam boilers and hot water heating boilers.
2. Explain the operation of the common control switches found on a low-pressure heating boiler.
3. Describe the operation of the safety switches found on the fuel supplies of low-pressure heating boilers.
4. Explain the required testing and maintenance of heating boiler controls.

Chapter 111(43): Heating Boiler Combustion Controls

Explain the design and operation of various combustion controls on heating boilers.

1. Describe the construction and operation of heating boiler flame failure detectors.
2. Describe the testing of hot water heating boiler, flame failure safety devices.

Chapter 112(44): Pneumatic Controls for Heating Systems

Explain the purpose of the various components found in a pneumatic control system.

1. Describe the layout of a pneumatic control system, and the construction and operation of pneumatic controllers.
2. Describe the construction and operation of final control elements.
3. Explain the function of pneumatic-electric switches and relays, manual pneumatic selector switches, gradual switches, and 3 way air valves.
4. Describe a typical self-contained pneumatic control system.

Chapter 113(45): Electric Controls for Heating Systems

Describe and explain the function of the various components of an electric control circuit.

1. Describe the basic construction and operation of electrical thermostats, humidity controllers and pressure controllers.
2. Describe the function and operation of the controlled devices in an electrical control systems.
3. Explain the operating sequence of a basic electric control circuit.

Chapter 114(46): Electronic Controls for Heating Systems

Describe and explain the function of the various components of an electronic control circuit.

1. Sketch and describe a simple electronic control system.
2. Describe the common types of temperature, humidity and pressure sensors used in HVAC electronic control systems.
3. Describe the types of controllers used in HVAC electronic control systems, and their respective functions.
4. Describe the output devices in an HVAC electronic control system.

**UNIT 24 AUXILIARY BUILDING SYSTEMS**

Chapter 115(47): Lighting Systems

Explain the various lighting systems and some of the basic design considerations for lighting a space.

1. Describe the common types of lighting equipment and systems.
2. Explain the various methods of lighting control.
3. Describe the general requirements and criteria for emergency lighting in buildings.
4. Discuss the interrelationship between lighting, air conditioning, and energy conservation in buildings.

Chapter 116(48): Building Water Supply Systems

Explain the various water supply systems in a building.

1. Describe the cold water distribution system in a building.
2. Describe the hot water distribution system in a building.
3. Describe the construction and operation of building system hot water heaters.
4. Explain what is meant by "backflow prevention" and describe the common methods used.
5. List and describe the construction and operation of water system protective devices in buildings.

Chapter 117(49): Sanitary Drainage Systems

Describe the various sanitary drainage systems employed with buildings.

1. Describe the overall layout of building drainage systems.
2. Describe storm water drainage systems for buildings.
3. List the steps to take in the routine maintenance of building sanitary drainage system devices.
4. Apply a troubleshooting guide for sanitary drainage systems.

## TRANSFERABILITY:

**** Grade of D or D+ may not be acceptable for transfer to other post-secondary institutions. Students are cautioned that it is their responsibility to contact the receiving institutions to ensure transferability**

## GRADING CRITERIA:

| Method | Percentage | Minimum |
|---|---|---|
| Course assignments/workbooks | 15% | 50% |
| CML quizzes | 15% | 50% |
| Unit Exams | 30% | 50% |
| Final Exam | 40% | 50% |
| | 100% | 50% |
| | | 65% average, with no mark below 50% |

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|---|---|---|---|
| **GRADING CONVERSION CHART** | | | |
| **Alpha Grade** | **4-point Equivalent** | **Percentage Guidelines** | **Designation** |
| **$A^+$** | **4.0** | **90 – 100** | **EXCELLENT** |
| **A** | **4.0** | **85 – 89** | |
| **$A^-$** | **3.7** | **80 – 84** | **FIRST CLASS STANDING** |
| **$B^+$** | **3.3** | **77 – 79** | |
| **B** | **3.0** | **73 – 76** | **GOOD** |
| **$B^-$** | **2.7** | **70 – 72** | |
| **$C^+$** | **2.3** | **67 – 69** | **SATISFACTORY** |
| **C** | **2.0** | **63 – 66** | |
| **$C^-$** | **1.7** | **60 – 62** | |
| **$D^+$** | **1.3** | **55 – 59** | **MINIMAL PASS** |
| **D** | **1.0** | **50 – 54** | |
| **F** | **0.0** | **0 – 49** | **FAIL** |
| **WF** | **0.0** | **0** | **FAIL, withdrawal after the deadline** |

**EVALUATIONS:**

**STUDENT RESPONSIBILITIES:**

**STATEMENT ON PLAGIARISM AND CHEATING:**

Please refer to pages 49-50 of the College calendar regarding plagiarism, cheating and the resultant penalties. These are serious issues and will be dealt with severely.

**COURSE SCHEDULE/TENTATIVE TIMELINE:**