MARYLAND APPLIED
GRADUATE ENGINEERING

Course: ENPM 621 – Heat Pump and Refrigeration Systems Design Analysis
Semester: Spring Year: Choose an item.
Day(s): TBD
Time: TBD
Location: TBD
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Course Description

The course deals with system- and component-level design and analysis of HVAC&R systems. Modern residential heat pump systems using vapor compression cycle is the focus. Other systems such as absorption/adsorption systems and refrigerators will also be covered in the course. Heat exchangers are the main focus of component-level design and analysis. Design and performance optimization of traditional tube-and-fin heat exchangers and microchannel heat exchangers will be discussed in detail. Students will be familiar with all above topics through mini-design type of projects throughout the class. In addition, environmental emissions of HVAC&R systems using various refrigerants will be assessed using Life Cycle Climate Performance (LCCP) Tools. The course will also briefly introduce the transient characteristics of heat pump systems during system start-up, shut-down and frosting.

Prerequisites:

Undergraduate heat transfer, fluid mechanics and thermodynamics

Course Evaluation:

Mid-term and final exams, based on text problems, will constitute on third each. The sum of the extensive home problems is the other third.

Required/Recommended Textbooks

Text:

"Thermal Environmental Engineering" 3rd edition, by Kuehn, Ramsey, Threlkeld, Prentice Hall Publisher. ISBN # 0-13-917220-3 Recommended

“Vapor Compression Heat Pumps with Refrigerant Mixtures” by Radermacher, Hwang, CRC Press, ISBN # 0-8493-3489-6 Recommended

Course Outline

No prior refrigeration theory background is required;

Vapor compression cycle and working fluids

(EES analysis of fluids and cycles) The effects of subcooling and superheating for various operating conditions will be quantified, then explained on working fluid properties basis

Condensers and evaporators (fin-and-tube, microchannel)

Expansion devices and controls (capillary tube and TXV)

Component topics are dealt with in a lecture manner so that their performance will be understood on a fundamental level. Through curve fitting of catalogue data and/or coefficient evaluation of first principles simulations it is possible to construct a model of a more realistic system. Possible modeling topics are:

Heat exchanger simulation and optimization

Basic vapor compression cycle with a liquid line/suction line heat exchanger and/or an expansion engine in lieu of an expansion valve.

Multi-stage Systems (Mini-design type problem, using EES will be conducted to optimize and industrial refrigeration problem).

Elementary analysis of the lithium-bromide absorption cycle leading to an EES simulation of steady state performance.

Residential heat load estimation

Direct and indirect HVAC&R system emissions (LCCP tool)