ME 4321 Refrigeration and Air Conditioning (Elective)

Catalog Description: ME 4321 Refrigeration and Air Conditioning (3-0-3)
Prerequisites: ME 3345 Heat Transfer
Engineering of heating, ventilating, and air conditioning (HVAC) systems including psychrometrics, ventilation requirements, load estimates, and building energy system design, simulation, and control.

Textbook: Stephen P. Kavanaugh, *HVAC Simplified*, ASHRAE, 2006.

Topics Covered:

1. Overview of HVAC and methods for controlling the indoor environment.
2. Brief overview of HVAC system alternatives and system design and selection.
3. Overview of refrigeration for HVAC.
4. Basic and applied psychrometrics.
5. Cooling and dehumidification processes.
6. Heat transfer in building walls, panels, and fenestration.
7. Thermal comfort conditions and ASHRAE Standard 55.
8. Outdoor air ventilation requirements and ASHRAE Standard 62.
9. Supply air calculations for zones and buildings.
10. Overview of HVAC weather design conditions.
11. Solar radiation principles, solar geometry, solar heat gain, and sol-air temperature.
12. Details of cooling load calculations by CLTD/CLF/SCL for zones and buildings.
13. Overview of building energy system simulations, with Energy-plus for example.
14. Briefing on heating load calculations.
15. Fluid flow distribution: duct and piping system design.
16. Room air distribution and the ADPI, including CFD analysis or results when feasible.
17. Evaluating energy conservation opportunities and ASHRAE Standard 90.
18. Advanced, innovative, or alternative system designs, comparison with contemporary designs.

Course Outcomes:

Outcome 1: Introduce students to HVAC technology, engineering, research, systems, system designs, energy impacts, and overall goals.

1.1 Students will demonstrate an understanding of the need and importance of HVAC technology, the typical and some advanced and innovative schematic designs, and the goals of HVAC engineering and HVAC systems.

Outcome 2: Develop understanding of the principles and practice of thermal comfort.

2.1 Students will demonstrate an understanding thermal comfort conditions with respect to temperature and humidity and human clothing and activities and its impact on human comfort, productivity, and health.

Outcome 3: Develop understanding of the principles and practice and requirements of ventilation.

3.1 Students will demonstrate an understanding of the needs and requirements for ventilation and its impact on design and energy and its impact on human comfort, productivity, and health.

Outcome 4: Develop generalized psychrometrics of moist air and apply to HVAC processes.

4.1 Students will demonstrate an understanding of psychrometrics and its application in HVAC engineering and design and will practice or observe psychrometric measurements.

Outcome 5: Review heat transfer and solar energy engineering and develop techniques for the analysis of building envelope loads.

5.1 Students will demonstrate an understanding of heat transfer in buildings with a given architectural design and its application to heating and cooling load estimation especially including thermal lag effects by conducting a detailed annual load analysis for a representative building and present the results of this analysis in a formal report possibly including recommendations for energy conservation.

Outcome 6: Review thermodynamics and thermal systems engineering and develop understanding of vapor compression and possibly heat-driven refrigeration systems and evaporative cooling systems.

6.1 Students will demonstrate an understanding of the engineering and operation of vapor compression and possibly heat-driven refrigeration systems and evaporative cooling systems and understand contemporary issues of ozone depletion and global warming potential with respect to refrigeration systems.

Outcome 7: Review fluid mechanics and engineering and develop techniques for the analysis of duct and piping systems and room air distribution systems and review associated turbomachines and control systems.

7.1 Students will demonstrate an understanding of fluid mechanics in building air or coolant distribution systems and in room air distribution and its application to efficient piping and duct systems and effective room air distribution systems and associated flow machines and control systems.

Outcome 8: Present overview of methods to predict seasonal and annual energy consumption and overview design guidelines and standards for energy efficient buildings and building energy systems.

8.1 Students will demonstrate a working understanding of energy prediction methods and energy related codes and standards and understand contemporary issues of energy conservation and global warming potential with respect to HVAC systems.

Correlation between Course Outcomes and Student Outcomes:

ME 4321											
	Mechanical Engineering Student Outcomes										
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Outcome 1.1			X			X			X	X	
Course Outcome 2.1	X		X			X		X			X
Course Outcome 3.1	X		X			X		X		X	X
Course Outcome 4.1	X	X			X						
Course Outcome 5.1	X	X	X	X	X	X	X	X	X	X	X
Course Outcome 6.1	X		X		X			X	X	X	
Course Outcome 7.1	X		X	X	X					X	X
Course Outcome 8.1	X	X		X	X	X		X	X	X	X

GWW School of Mechanical Engineering Student Outcomes:

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Prepared by: Sheldon Jeter