ME 4321 Refrigeration and Air Conditioning (Elective)

Catalog Description: ME 4321 Refrigeration and Air Conditioning (3-0-3)
Prerequisites: ME 3322 Thermodynamics and ME 3345 Heat Transfer

Application of thermodynamics, heat transfer, fluid mechanics, thermal comfort principles, and good practice to the analysis and design of air-conditioning, heating, and refrigeration systems; including consideration of vapor compression and heat-driven refrigeration, air-vapor psychrometrics, load estimates, air delivery and distribution, and building energy system controls.

Textbook: Harry J. Sauer, Ronald H. Howell, and William J. Coad, *Principles of Heating, Ventilating, and Air Conditioning*, ASHRAE, Current Ed.

Topics Covered:

1. Overview of HVAC and methods for controlling the indoor environment
2. Basic and applied psychrometrics
3. Thermal comfort conditions and ASHRAE Std 55
4. Outdoor air ventilation requirements and ASHRAE Std 62
5. Overview of system alternatives and system design and selection
6. Overview of HVAC design conditions and loads
7. Heat transfer in building walls, panels, and fenestration
8. Solar radiation principles, solar geometry, Solar Heat Gain, Sol-air temperature
9. Details of load calculations by CLTD/CLF/SCL for zones and building
10. Overview of the RTS method and building simulations
11. Heating load calculations
12. Supply air calculations for zones and building
13. Overall flow rates and refrigeration loads (at the AHU)
14. Cooling and dehumidification processes
15. Cooling and dehumidification systems, refrigerant selection
16. Fluid flow distribution: duct and piping system design
17. Room air distribution and the ADPI including CFD analysis when feasible
18. Estimating energy consumption
19. Evaluating energy conservation opportunities and ASHRAE Std 90
20. 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 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 energy prediction methods and energy related codes and standards understand contemporary issues energy conservation and global warming potential with respect to HVAC systems

Correlation between Course Outcomes and Program Educational Outcomes:

ME 4321												
	Mechanical Engineering Program Educational Outcomes											
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k	l
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	X
Course Outcome 8.1	X	X		X	X	X		X	X	X	X	

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