

**Advanced Refrigeration (August 21, 2024)**  
**EML 5605 Sections CAMP (20064), 1FE2 (20066), 2FED (20067), OVER (20065)**  
**Class Periods: MWF, 7<sup>th</sup> period, 1:55-2:45pm (view recorded lectures)**  
**Location: NEB 0102**  
**Academic Term: Fall 2024**

**Instructor:**

Dr. SA Sherif, Professor  
Department of Mechanical and Aerospace Engineering  
1064 Center Drive  
235 NEB Building  
Gainesville, FL 32611  
Tel (352) 392-7821, [sasherif@ufl.edu](mailto:sasherif@ufl.edu)  
<https://faculty.eng.ufl.edu/sa-sherif/>  
Office Hours via Zoom: MWF 5:30-6:30pm

**Teaching Assistants: None**

**Course Description**

Analysis and design considerations for vapor compression, absorption, steam-jet, thermoelectric, and air refrigeration systems, 3 Credits.

**Course Pre-Requisites/Co-Requisites:** Graduate standing or permission of instructor

**Course Objectives**

Students will be able to analyze and design all types of refrigeration systems including vapor compression, vapor absorption, steam jet, thermoelectric, thermoacoustic, magnetic, and air refrigeration systems. Students will also be able to perform design calculations on refrigeration system components including air and water cooled condensers, flooded and dry-out evaporators, compressors of all types including reciprocating, centrifugal, screw, rotary-vane, and other compressor types, and metering and control devices including expansion valves and capillary tubes. Students will also be able to analyze and design liquid recirculation systems and perform refrigeration load calculations.

**Materials and Supply Fees: None**

**Required Textbooks and Software:** A series of handouts

**Recommended Materials**

1. *Modern Refrigerating Machines*, by I. Cerepnalkovski, Elsevier Science Publishers, Amsterdam, The Netherlands, 1991.
2. *Thermal Environmental Engineering*, Third Edition, by T.H. Kuehn, J.W. Ramsey, and J.L. Threlkeld. Prentice-Hall, Inc., Englewood Cliffs, NJ, 1998
3. *ASHRAE 2017 Handbook - Fundamentals*, ASHRAE, Inc., 1791 Tullie Circle, N.E., Atlanta, Georgia 30329.
3. Absorption Chillers and Heat Pumps, K.E. Herold, R. Radermacher, and S.A. Klein, CRC Press, Boca Raton, Florida, 1996.
3. *Industrial Refrigeration*, by W.F. Stoecker, Business News Publishing Co., Troy, Michigan, 1988.
4. *Industrial Refrigeration*, Volume II, by W.F. Stoecker, Business News Publishing Co., Troy, Michigan. 1995.
5. *ASHRAE 2018 Handbook - Refrigeration*, ASHRAE, Inc., Atlanta, Georgia, 2018.
6. *Heat Conversion Systems*, by G. Alefeld and R. Radermacher, CRC Press, Inc., Boca Raton, Florida, 1993.
7. *Refrigeration and Air Conditioning*, by W.F. Stoecker and J.W. Jones, McGraw-Hill, Inc., New York, 1986
8. *Entropy Generation Minimization*, by A. Bejan, CRC Press, Inc., Boca Raton, FL, 1996.

**Subjects**

1. Fundamental Theory of Refrigeration Cycles
2. Classification of Refrigerants (Types, Numbering System)
3. Single-Stage Vapor Compression Refrigeration Systems
4. Mechanical Vapor Compression Components and Systems
  - a. Refrigeration Compressors (Reciprocating, Centrifugal, Screw, Vane, Rolling Piston)
  - b. Condensers (Shell-and-Tube, Fin-and-Tube, Plate)
  - c. Evaporators (Flooded, Dry-Out, Direct Expansion)
  - d. Expansion Devices (Throttle Valves, Capillary Tubes)
5. Complex and Multi-Stage Vapor Compression Refrigeration Systems

6. Liquid Recirculation Systems
7. Valves and Refrigerant Controls
9. Absorption Refrigeration Systems
  - a. Absorption Cycle Fundamentals
  - b. Properties of Working Fluids
  - c. Thermodynamic Processes with Mixtures
  - d. Overview of Water/Lithium-Bromide Technology
  - e. Single-Effect Water/Lithium-Bromide Systems
  - f. Multiple-Effect Water/Lithium Bromide Systems
  - g. Single-Stage Ammonia/Water Systems
  - h. Multi-Stage Ammonia/Water Systems
10. Air Compression Refrigeration Systems
11. Steam-Jet and Jet-Ejector Refrigeration Systems
12. Thermoelectric Refrigeration
13. Flash Cooling
14. Thermoacoustic Refrigeration
15. Magnetic Refrigeration
16. Refrigeration Load Calculations

### **Attendance Policy, Class Expectations, and Make-Up Policy**

Watching the video lectures online is a necessary condition but it is not a sufficient one to be able to do well in this class. It is expected that 3 to 5 study hours for each contact hour are to be spent every week studying for this class. If a week is missed, the study hours need to be made up in the following weeks. Homework problems will be assigned via Canvas and submitted through Canvas. **No email or hard copy submissions will be accepted.** You may upload homework assignments early, but not past the due date. The assignments will be due at 11:59pm on the due date. After that, the system will stop accepting the assignments. Late homework is not accepted via any other means. **I am available 24/7 via 352-392-7821 or [sasherif@ufl.edu](mailto:sasherif@ufl.edu)**

<u>Lecture #</u>	<u>Topic Covered</u>	<u>Lecture #</u>	<u>Topic Covered</u>
Lecture 1	Fundamentals of refrigeration theory 1	Lecture 29	Evaporators (analysis/design) 2
Lecture 2	Fundamentals of refrigeration theory 2	Lecture 30	Evaporators (analysis/design) 3
Lecture 3	Refrigerants 1	Lecture 31	Evaporators (analysis/design) 4
Lecture 4	Refrigerants 2	Lecture 32	Evaporators (analysis/design) 5
Lecture 5	Vapor compression refrigeration cycle 1	Lecture 33	Evaporators (analysis/design) 6
Lecture 6	Vapor compression refrigeration cycle 2	Lecture 34	Evaporators (analysis/design) 7
Lecture 7	Compressors (analysis/design) 1	Lecture 35	Absorption refrigeration 1
Lecture 8	Compressors (analysis/design) 2	Lecture 36	Absorption refrigeration 2
Lecture 9	Compressors (analysis/design) 3	Lecture 37	Absorption refrigeration 3
Lecture 10	Compressors (analysis/design) 4	Lecture 38	Absorption refrigeration 4
Lecture 11	Compressors (analysis/design) 5	Lecture 39	Absorption refrigeration 5
Lecture 12	Compressors (analysis/design) 6	Lecture 40	Absorption refrigeration 6
Lecture 13	Compressors (analysis/design) 7	Lecture 41	Absorption refrigeration 7
Lecture 14	Condensers (analysis/design) 1	Lecture 42	Absorption refrigeration 8
Lecture 15	Condensers (analysis/design) 2	Lecture 43	Multistage vapor compression refrigeration systems
Lecture 16	Condensers (analysis/design) 3	Lecture 44	Thermoelectric refrigeration systems 1
Lecture 17	Condensers (analysis/design) 4	Lecture 45	Thermoelectric refrigeration systems 2
Lecture 18	Condensers (analysis/design) 5	Lecture 46	Flash cooling/steam-jet refrigeration/air refrigeration
Lecture 19	Condensers (analysis/design) 6	Lecture 47	Thermoacoustic refrigeration/magnetic refrigeration
Lecture 20	Condensers (analysis/design) 7	Lecture 48	Liquid recirculation systems
Lecture 21	Condensers (analysis/design) 8	Lecture 49	Expansion devices (capillary tube design) 1
Lecture 22	Condensers (analysis/design) 9	Lecture 50	Expansion devices (capillary tube design) 2
Lecture 23	Condensers (analysis/design) 10	Lecture 51	Expansion devices (expansion valves)
Lecture 24	Condensers (analysis/design) 11	Lecture 52	Refrigeration load calculations (cooler)
Lecture 25	Condensers (analysis/design) 12	Lecture 53	Refrigeration load calculations (cooler)
Lecture 26	Condensers (analysis/design) 13	Lecture 54	Refrigeration load calculations (cooler/freezer)
Lecture 27	Condensers (analysis/design) 14	Lecture 55	Refrigeration load calculations (freezer)
Lecture 28	Evaporators (analysis/design) 1		

## Evaluation of Grades

Exam 1 (take-home covering Lectures 1 through 34), released October 28, 2024 50%

Exam 2 (take-home covering Lectures 28 through 55), released December 2, 2024 50%

HW Assignments: 3% of the course grade will be deducted per missed assignment

## Grading Policy

Percent	Grade	Grade Points
90.0 - 100.0	A	4.00
86.0 - 90.00	A-	3.67
82.0 - 86.0	B+	3.33
78.0 - 82.0	B	3.00
74.0 - 78.0	B-	2.67
70.0 - 74.0	C+	2.33
66.0 - 70.0	C	2.00
62.0 - 66.0	C-	1.67
58.0 - 62.0	D+	1.33
54.0 - 58.0	D	1.00
50.0 - 54.0	D-	0.67
0 - 50.0	E	0.00

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

## Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

## Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

## In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

### **University Honesty Policy**

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies several behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### **Commitment to a Safe and Inclusive Learning Environment**

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University’s core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Coordinator
- HWCHE Human Resources, 352-392-0904, [student-support-hr@eng.ufl.edu](mailto:student-support-hr@eng.ufl.edu)
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, [pld@ufl.edu](mailto:pld@ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto:nishida@eng.ufl.edu)

### **Software Use**

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

### **Student Privacy**

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

### **Campus Resources:**

#### **Health and Wellness**

#### **U Matter, We Care:**

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

**Counseling and Wellness Center:** <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

#### **Sexual Discrimination, Harassment, Assault, or Violence**

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the [Office of Title IX Compliance](#), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)

#### **Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

## **Academic Resources**

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://elearning.ufl.edu/>.

**Career Connections Center**, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.

**Writing Studio, 302 Tigert Hall**, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus**: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

**On-Line Students Complaints**: <https://distance.ufl.edu/getting-help/>; <https://distance.ufl.edu/state-authorization-status/#student-complaint>.