King Fahd University of Petroleum & Minerals
MECHANICAL ENGINEERING DEPARTMENT
ME 431: Refrigeration

Catalogue Description: (3-0-3)
Mechanical vapor compression refrigeration cycles (single-stage and multi-stage); refrigerant compressors; refrigerants; absorption refrigeration systems; thermoelectric cooling; flash cooling; gas cycle refrigeration; ultra-low-temperature refrigeration (cryogenics); food refrigeration; transport refrigeration; Design and performance evaluation problems in refrigeration systems and applications.

Status in Curriculum (Required or Elective): Elective

Prerequisites:ME 204, ME 315

Co-requisites: None

Prerequisites by Topics:
1) Basic thermodynamics of refrigeration cycles (ME 203, ME 204)
2) Basic thermodynamics properties of absorption cycles (ME 204)
3) Basics of fluid mechanics and conservation of mass, and conservation of energy. (ME 203)
4) Basics of different modes of heat transfer (ME 315)

Textbook:T. H. Kuehn, J. W. Ramsey, and J. L. Threlkeld, Thermal Environmental Engineering, 3rd Edition, Prentice Hall, Inc., 1998.

References:

1. ASHRAE Handbook: Refrigeration System and Applications, 1998 Edition.
2. ARI Handbook: Refrigeration and Air-Conditioning, 2nd Edition, 1987

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Goals:(general objectives)
1. Introduce basic principles of various types of refrigeration systems, including food and transport refrigeration.
2. Teach students to design and analyze various types of refrigeration systems.
3. Familiarize students with engineering equation solver and its use in refrigeration system design.

Course Outline (Lecture Topics):

1.	Mechanical vapor-compression refrigeration cycles	(10 Classes)
2.	Vapor-compression system analysis	(4 Classes)
3.	Binary mixtures and absorption refrigeration	(7 Classes)
4.	Thermoelectric cooling	(4 Classes)
5.	Flash cooling	(2 Classes)
6.	Gas cycle refrigeration	(4 Classes)
7.	Ultra-low-temperature refrigeration: cryogenics	(6 Classes)
8.	Food and transport refrigeration	(6 Classes)
9.	Tests	(2 Classes)

Design Activities/Projects:
A major project on design of a refrigeration system will be assigned. In this project, the student will be given the range of temperature required and the type of products to be cooled. Students will work individually and in groups to come up with the proper system and its detailed design. The student(s) will submit a written report and conduct and oral presentation for their report. Economic and environmental impact of the designed system will be discussed.

Computer Usage:
Students will be encouraged to model and simulate different refrigeration systems using EES software and/or other software's available. They will be also using Excel and other software to analyze their data and plot it.

Laboratory: None

Assessment Tools:

i- Two Major Examinations
ii- Homework Assignments and Term Project
iii- Quizzes
iv- Final Exam (comprehensive)

Course Learning Outcomes:

1. Demonstrate basic understanding of several types of refrigeration systems that will include vapor compression, vapor absorption, thermoelectric cooling, flash cooling, and gas cycle refrigeration.
2. Identify capabilities and limitations of different refrigeration systems in terms of their performance, energy requirements, maintenance and economic considerations, etc.
3. Demonstrate the operation of several key components in a refrigeration cycle.
4. Explain the proper selection of components in refrigeration systems.
5. Explain how to maximize the performance of a refrigeration system.
6. Demonstrate ability to use EES and EXCEL in solving open-ended design problems.
7. Demonstrate ability to estimate the economic and environmental impact of refrigeration systems design and performance
8. present their works in form of technical reports and oral presentation including graphic presentations

Course Learning Outcomes mapped to Student Outcomes:

Student Outcomes	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*
Course-to-Student outcome mapping	1, 2	2, 3	2, 3, 4, 5	2, 3, 4, 5, 6	2, 3, 4	2, 5	6, 8	7	2	2, 5	6
Emphasis*	**S**	S	**S**	S	**S**	M	S	S	M		S

* **L**: Little/None **M**: Moderate **S**: Strong

Status of Continuous Improvement review of this Course:

Date reviewed: March 9, 2015 **Reviewed by:** Thermo Fluid Science Group
Prepared by: Dr. Esmail M. A. Mokheimer **Date prepared:** January 2012