King Fahd University of Petroleum & Minerals
MECHANICAL ENGINEERING DEPARTMENT
ME 204: Thermodynamics II

Catalogue Description: (3-0-3)

Irreversibility and availability. Power and refrigeration cycles: steam power cycles, air-standard power cycles, and refrigeration cycles. Gas-gas and gas-water vapor mixtures. Psychrometrics. Thermodynamic relations: the Clapeyron equation, the Maxwell relations, and enthalpy and entropy departures. Chemical reactions: fuels and combustion processes.

Status in Curriculum (Required or Elective): Required (offered Fall & Spring)

Prerequisites: ME 203

Co-requisites: None

Prerequisites by Topics:

1. Thermodynamic concepts and definitions.
2. Properties of a pure substance.
3. Work and heat.
4. The First Law of Thermodynamics.
5. The First Law of analysis for a control volume.
6. The Second Law of Thermodynamics.
7. Entropy
8. The Second Law analysis for a control volume.

Textbook: **Yunus A. Cengel and Michael A. Boles, Thermodynamics: An Engineering Approach, 7th Edition, McGraw Hill, 2002**.

References:

1) **Sonntag, R. E., Borgnakke, C., and Van Wylen, G. J. Fundamentals of Thermodynamics, 6th Edition, John Wiley & Sons, Inc., 2003.**
2) **Moran, M. J., and H. N. Shapiro. Fundamentals of Engineering Thermodynamics, 5th Edition, John Wiley & Sons, Inc., 2004.**.

Coordinator: **Dr. Haitham Bahaidarah,** AssociateProfessor of Mechanical Engineering

Goals: **(general objectives)**

To provide a comprehensive study of power and refrigeration cycles and systems, gas and water vapor mixtures, psychrometrics, Thermodynamic relations for simple compressible substances, fuels and combustion processes in the field of thermal sciences as well as applications of the first and second laws of Thermodynamics to such thermal systems and processes.

Course Outline (Lecture Topics):

1)	Review of the First and Second Laws of Thermodynamics and entropy.	2 Classes
2)	Measure of Work Potential (availability/exergy) and Irreversibility (Chapter 7).	6 Classes
3)	Gas Power Cycles (Chapter 8).	6 Classes
4)	Vapor and Combined Power Cycles (Chapter 9).	5 Classes
5)	Refrigeration Cycles (Chapter 10).	4 Classes
6)	Thermodynamic Property Relations and Generalized Charts (Chapter 11).	6 Classes
7)	Gas Mixtures (Chapter 12).	2 Classes
8)	Gas-Vapor Mixtures and Air-Conditioning (Chapter 13).	4 Classes
9)	Chemical reactions (combustion) (Chapter 14).	7 Classes
10)	Tests.	3 Classes

Design Activities/Projects:

One design project on either one of the power cycles or vapor-compression refrigeration cycle is assigned to be done using the software of Engineering Equation Solver "EES," covering design calculations and parametric studies.

Computer Usage:

Students use computer softwares on the Thermodynamic data, psychrometrics and design calculations of power and refrigeration cycles.

Laboratory:

None

Assessment Tools:

i- Mid-term Examinations
ii- Homework Assignments
iii- Quizzes
iv- Final Exam

Course Learning Outcomes:

By the end of this course students would be able to:

I. Demonstrate an **understanding of** the thermodynamic terms **availability (exergy), reversible work, irreversibility (lost work or exergy destruction) and second law efficiency**.

II. Utilize the terms in 1 to **evaluate the performance of thermodynamic processes and thermal Equipment.**

III. Demonstrate an **understanding of** different **thermodynamic cycles for power generation and Refrigeration.**

IV. **Evaluate the thermal performance of different heat engines and refrigeration cycles** through the calculation of their thermal efficiency or coefficient of performance.

V. **Develop relations that link thermodynamic properties that cannot be measured directly** in the lab to **measurable properties such as temperature pressure and volume.**

VI. **Differentiate between ideal gas and real gases and use generalized charts.**

VII. **Demonstrate ability to obtain the properties of a mixture from the properties of its individual components.**

VIII. **Apply the first and second laws of Thermodynamics on systems dealing with mixtures with special reference to air conditioning equipment.**

IX. **Analyze different combustion processes and apply the first law of Thermodynamics on reacting systems.**

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	I, III, IV		II, V		II, III, IV, V			VI			
Emphasis*	**S**		**M**		**L**			**L**			

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

Status of Continuous Improvement review of this Course:

Date reviewed: **Reviewed by:** Thermal Science Group

Prepared by: Dr. Haitham Bahaidarah **Date prepared:** 4 Feb 2015