OFFICIAL UNDERGRADUATE COURSE OUTLINE (page 1)

COURSE IMPLEMENTATION DATE:	September 1992
COURSE REVISED IMPLEMENTATION DATE:	May 2014
COURSE TO BE REVIEWED:	May 2020
(six years after UEC approval)	*(month, year)*

OFFICIAL UNDERGRADUATE COURSE OUTLINE INFORMATION

Students are advised to keep course outlines in personal files for future use.
Shaded headings are subject to change at the discretion of the department – see course syllabus available from instructor

PHYS 231	Faculty of Science / Physics	3
COURSE NAME/NUMBER	FACULTY/DEPARTMENT	UFV CREDITS

Thermodynamics
COURSE DESCRIPTIVE TITLE

CALENDAR DESCRIPTION:

Pressure, temperature, kinetic theory, and the Maxwell velocity distribution; heat, work, and the first law; heat capacities, equations of state, and exact and inexact differentials; isothermal, isobaric, isochoric and adiabatic processes, heat engines, phase diagrams, and thermodynamic cycles; thermal expansion, conductive, convective and radiative heat losses, entropy, and the second law.

PREREQUISITES: PHYS 112
COREQUISITES:
PRE or COREQUISITES: None. Note: As of May 2015, pre or corequisites will change to the following: MATH 211

SYNONYMOUS COURSE(S):
(a) Replaces:
(b) Cross-listed with:
(c) Cannot take: for further credit.

SERVICE COURSE TO: *(department/program)*

TOTAL HOURS PER TERM: **75**

STRUCTURE OF HOURS:

Lectures:	**75**	Hrs
Seminar:		Hrs
Laboratory:		Hrs
Field experience:		Hrs
Student directed learning:		Hrs
Other (specify):		Hrs

TRAINING DAY-BASED INSTRUCTION:
Length of course:
Hours per day:

OTHER:
Maximum enrolment: **36**
Expected frequency of course offerings: annually
(every semester, annually, every other year, etc.)

WILL TRANSFER CREDIT BE REQUESTED? (lower-level courses only)	☐ Yes	☐ No
WILL TRANSFER CREDIT BE REQUESTED? (upper-level requested by department)	☒ Yes	☐ No
TRANSFER CREDIT EXISTS IN BCCAT TRANSFER GUIDE:	☐ Yes	☐ No

Course designer(s):	**George McGuire; revised Rob Woodside** (2013 - revised by Jeff Chizma)		
Department Head:	**Derek Harnett**	Date approved:	**Aug 26, 2013**
Campus-Wide Consultation (CWC)		Date of meeting:	**Sept 27, 2013**
Curriculum Committee chair:	**David Fenske**	Date approved:	**October 18, 2013**
Dean/Associate VP:	**Lucy Lee**	Date approved:	**October 18, 2013**
Undergraduate Education Committee (UEC) approval		Date of meeting:	**January 31, 2014**

LEARNING OUTCOMES:

Upon successful completion of this course, students will be able to:

- Apply Boltzmann statistics to calculate averages of kinematic quantities in a simple thermodynamic system
- Explain the origin, importance, relationships, and methods of measuring the fundamental thermodynamic quantities of temperature, pressure, and volume
- State two of the three laws of Thermodynamics, and apply them to simple thermal systems
- Perform calculations involving partial derivatives for both exact and inexact differentials
- Determine various thermodynamic quantities for specific types of processes (eg. Isochoric, Isobaric, Isothermal, and Adiabatic)
- Calculate thermal expansions and thermal heat loss via conduction, convection, and radiation for simple but relevant situations
- Utilize the properties of exact and inexact differentials under closed loop integration to demonstrate the difference between reversible and irreversible thermodynamic processes
- Show and explain the difference between constant pressure and constant volume heat capacities
- Use the equation of state of a system to determine quantities like its internal energy, entropy, and heat capacities
- Read a phase diagram and be able to identify the regions of solid, liquid, and gas phases along with the triple and critical points
- Draw and explain diagrams of simple heat engines (Otto, Diesel, etc) and refrigeration cycles

METHODS: *(Guest lecturers, presentations, online instruction, field trips, etc.)*

This course will be taught using lectures, demonstrations, and seminars. Problems will be assigned and marked on a regular basis.

METHODS OF OBTAINING PRIOR LEARNING ASSESSMENT RECOGNITION (PLAR):

☐ Examination(s) ☐ Portfolio assessment ☐ Interview(s)

☒ Other (specify): Please see the Physics PLAR policy on the department's webpage.

☐ PLAR cannot be awarded for this course for the following reason(s):

TEXTBOOKS, REFERENCES, MATERIALS: *[Textbook selection varies by instructor. An example of texts for this course might be:]*

Introduction to Modern Thermodynamics, Dilip Kondepudi**,** Wiley (2008)
Fundamentals of Statistical and Thermal Physics, F. Reif, Waveland Press (2008)

SUPPLIES / MATERIALS:

STUDENT EVALUATION: *[An example of student evaluation for this course might be:]*

Assignments:	30%
Term test:	30%
Final exam:	40%

COURSE CONTENT: *[Course content varies by instructor. An example of course content might be:]*

1. **Overview of the basic concepts of Thermodynamics**
   - Equilibrium systems and the zeroth law, temperature, thermal expansion, heat, pressure, ideal gas law, van der Waals equation, the kinetic theory of gases, Boltzmann distribution, intensive and extensive parameters, Avogadro's number, molar mass, thermal expansion, thermal conductivity, thermal radiation

2. **The First Law of Thermodynamics**
   - Heat and energy conservation, work, heat capacity/specific heat, isothermal process, isochoric process, isobaric process, adiabatic process, enthalpy, exact and inexact differentials

3. **The Second Law of Thermodynamics**
   - Reversible and irreversible processes, entropy, Clausius inequality, arrow of time

4. **Thermodynamic Relationships**
   - Gibbs free energy, Helmholtz free energy, Maxwell relations, compressibility of a gas

5. **Thermodynamics of Solids, Liquids, and Gases**
   - Ideal and real gases, phase transitions between solids, liquids, and gases, latent heat, phase diagrams, refrigeration, simple thermal engines (Otto cycle, Diesel cycle, etc.)