CALIFORNIA STATE UNIVERSITY CHANNEL ISLANDS

NEW COURSE PROPOSAL

DATE SEPTEMBER 13, 2006
PROGRAM AREA MATH AND APPLIED PHYSICS

1. Catalog Description of the Course. *[Follow accepted catalog format.]*

Prefix PHYS Course# 305 Title THERMAL AND STATISTICAL PHYSICS Units (3)
3 hours lecture per week
☒ Prerequisites PHYS 201, MATH 350
☐ Corequisites
Description Addesses the behavior of energy and matter in systems having a great many particles. Includes both classical and quantum mechanical views of physical systems and begins with the basic concepts of probability and statistics. Particular emphasis will be placed on simple model systems for which quantitative results can be obtained and compared to experiment, such as ideal gases and quantum mechanical spin systems. The course includes the statistics of the microcanonical, canonical, and grand canonical ensembles; the relation between classical and quantum statistical mechanics; the Planck distribution, bosons, fermions, and doped semiconductors, among others; and an introduction to kinetic theory.

☐ Gen Ed Categories — Graded: ☐ CR/NC ☒ A - Z — ☐ Repeatable for up to units
☐ Lab Fee Required — Total Completions Allowed
☐ Mission Based Learning Objectives: ☐Interdisciplinary ☐ International ☐Multicultural ☐Service Learning
☐ Title V Section 40404: ☐Government ☐US Constitution ☐US History

2. Mode of Instruction.

	Units	Hours per Unit	Benchmark Enrollment	Graded Component	CS # (filled in by Dean)
Lecture	3	1	24	☒	
Seminar				☐	
Laboratory				☐	
Activity				☐	

3. Justification and Learning Objectives for the Course. (Indicate whether required or elective, and whether it meets University Writing, and/or Language requirements) *[Use as much space as necessary]*

This course is an elective for applied physics majors who wish to pursue graduate study in physics, applied physics or engineering.

The goal of this course is to investigate the behavior of systems with large numbers of particles and to find how the standard concepts of thermal physics (temperature, entropy, free energy) arise from basic probability and simple mechanics.

Students who successfully complete this course will be able to
- explain the basic concepts and principles of thermodynamics and statistical physics
- describe the properties of bulk materials in statistical terms
- describe the properties of ideal gases
- define entropy and thermodynamic variables
- use canonical ensembles
- use probability theory and game theory
- explain strongly interacting systems
- describe examples and applications of thermodynamics and statistical physics in everyday life
- apply problem-solving skills to practical problems in thermodynamics and statistical physics
- demonstrate the role of thermodynamics and statistical physics in other disciplines, and apply their understanding to these disciplines

The course does not meet the University Writing and/or Language requirements.

4. Is this a General Education Course **YES** ☐ **NO** ☒
If Yes, indicate GE category and attach GE Criteria Form:

A (English Language, Communication, Critical Thinking)	
A-1 Oral Communication	☐
A-2 English Writing	☐
A-3 Critical Thinking	☐
B (Mathematics, Sciences & Technology)	
B-1 Physical Sciences	☐
B-2 Life Sciences – Biology	☐
B-3 Mathematics – Mathematics and Applications	☐
B-4 Computers and Information Technology	☐
C (Fine Arts, Literature, Languages & Cultures)	
C-1 Art	☐
C-2 Literature Courses	☐
C-3a Language	☐
C-3b Multicultural	☐
D (Social Perspectives)	☐
E (Human Psychological and Physiological Perspectives)	☐
UD Interdisciplinary	☐

5. Course Content in Outline Form. *[Be as brief as possible, but use as much space as necessary]*

1. The properties of matter in bulk. What is statistical mechanics about? Fluid statics. Descriptive phase diagrams.
2. Principles of statistical mechanics. Probability, random numbers, games of chance. Statistical distributions: binomial, Gaussian, Boltzman, Poisson. Random Walk. The microcanonical ensemble. What is entropy?
3. Thermodynamics. Basics. Heat and work. Applications to fluids, to phase transitions, to chemical reactions, and to light.
4. Ensembles. More principles of statistical mechanics. Canonical, grand canonical, and other ensembles. Temperature and chemical potential as control parameters.
5. Classical ideal gases.
6. Quantum ideal gases. Fermi-Dirac and Bose-Einstein statistics.
7. Harmonic lattice vibrations. Phonons.
8. Strongly interacting systems and phase transitions. Magnetic systems. Mean field approximation, transfer matrices, computer simulations. Polymers, antiferromagnets.

Does this course overlap a course offered in your academic program? YES ☐ NO ☒
If YES, what course(s) and provide a justification of the overlap?

Does this course overlap a course offered in another academic area? YES ☐ NO ☒
If YES, what course(s) and provide a justification of the overlap?
Signature of Academic Chair of the other academic area is required on the consultation sheet below.

6. Cross-listed Courses (Please fill out separate form for each PREFIX)
List Cross-listed Courses

Signature of Academic Chair(s) of the other academic area(s) is required on the consultation sheet below

Department responsible for staffing: Physics

7. References. *[Provide 3 - 5 references on which this course is based and/or support it.]*

D. Schroeder, Introduction to Thermal Physics . (Addison-Wesley, 1999)
R. Baierlein, Thermal Physics (Cambridge University Press, 1999).
C. Kittel and H. Kroemer, Thermal Physics, 2nd ed (W. H. Freeman and Company, 1980).

8. List Faculty Qualified to Teach This Course.

Physics Faculty

9. Frequency.

a. Projected semesters to be offered: Fall ☐ Spring ☒ Summer ☐

10. New Resources Required. YES ☐ NO ☒

If YES, list the resources needed and obtain signatures from the appropriate programs/units on the consultation sheet below.

a. Computer (data processing), audio visual, broadcasting needs, other equipment)

b. Library needs

c. Facility/space needs

11. Will this new course alter any degree, credential, certificate, or minor in your program? YES ☒ NO ☐

If, YES attach a program modification form for all programs affected.

Dr. Geoff Dougherty	5/2/2006
Proposer of Course	Date

Approvals

_____

Program Chair Date

_____

Curriculum Committee Chair Date

_____

Dean Date

California State University Channel Islands
New Course Proposal Consultation Sheet

1. Course Title: PHYS 305 Thermal and Statistical Physics

2. Program Area: Math and Applied Physics

Recommend Approval

Program Area/Unit	**Program/Unit Chair**	**YES**	**NO** (attach objections)	**Date**
Art				
Biology				
Business & Economics				
Education				
English				
History				
Liberal Studies				
Mathematics & CS				
Multiple Programs				
Psychology				
Library				
Information Technology				