

ROWAN COLLEGE  
CURRICULUM COMMITTEE

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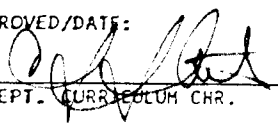

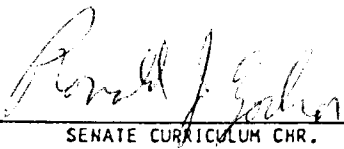


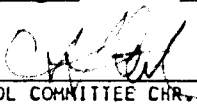
PROPOSAL TITLE: Chemical Engineering Thermodynamics 0906-310

UNDERGRADUATE       GRADUATE      3 CREDIT HOURS

SPONSOR(S): Dr. Z. Alan Keel and School of Engineering Curriculum Committee

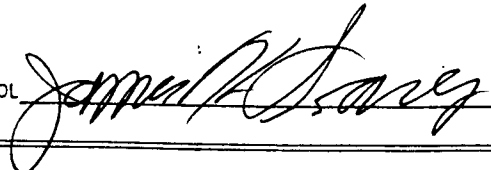
DEPARTMENT & TELEPHONE# \_\_\_\_\_

CHECK ONE:  COURSE       MINOR PROGRAM       CONCENTRATION       SPECIALIZATION  
 ACHIEVEMENT CERTIFICATE       CERTIFICATION PROGRAM       MAJOR PROGRAM

STEP #1 (DEPARTMENT)	STEP #2 (RECEIPT)	STEP #3 (SCHOOL)
<input checked="" type="checkbox"/> APPROVED/DATE: <u>4-8-97</u> <input type="checkbox"/> NOT APPROVED/DATE: _____  DEPT. CURRICULUM CHR.  <input checked="" type="checkbox"/> REVIEWED/DATE: <u>4-8-97</u>  DEPT. CHR.	SCC# <u>96-97-136</u> DATE RECEIVED: <u>4-16-97</u>   SENATE CURRICULUM CHR.	REVIEWED DATE: <u>4-9-97</u> <input checked="" type="checkbox"/> RECOMMEND TO APPROVE <input type="checkbox"/> RECOMMEND NOT TO APPROVE FORWARD FOR OPEN HEARING <input checked="" type="checkbox"/> WITHOUT RESERVATIONS <input type="checkbox"/> WITH RESERVATIONS COMMENTS: <input type="checkbox"/> TRC  <input type="checkbox"/> RAD  <input type="checkbox"/> JLS <input checked="" type="checkbox"/> CSS  SCHOOL COMMITTEE CHR.

STEP #4 (ACADEMIC DEAN)      COMMENTS:

RECOMMEND  
 NOT RECOMMEND  
 CONDITIONALLY RECOMMEND (SEE COMMENTS)

DATE & SIGNATURE, DEAN OF SCHOOL:  4/9/97

STEP #5 (SENATE CURRICULUM COMMITTEE)

DATE OF OPEN HEARING: 4-24-97

APPROVED BY SENATE CURRICULUM COMMITTEE (DATE) \_\_\_\_\_

RETURNED TO SPONSOR(S) FOR THE FOLLOWING REASONS:

\_\_\_\_\_

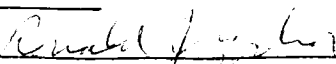
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STEP #6 (SENATE)

DATE PRESENTED TO SENATE \_\_\_\_\_

APPROVED       NOT APPROVED

NOTIFICATION TO EXECUTIVE VICE PRESIDENT/PROVOST (DATE) \_\_\_\_\_

SENATE CURRICULUM COMMITTEE CHAIR SIGNATURE/DATE:  5/21/97

STEP #7 (EXECUTIVE VICE PRESIDENT/PROVOST)

DATE RECEIVED: 2/1/97

APPROVED:  YES  NO

IF NO, REASONS ARE AS FOLLOWS:

STUDENT CREDIT HOURS \_\_\_\_\_

FACULTY LOAD HOURS \_\_\_\_\_

EQUALIZED CREDIT HOURS \_\_\_\_\_

OFFICIAL COPY & APPROVAL SHEET FILED (DATE) \_\_\_\_\_

SIGNATURE, EXECUTIVE VICE PRESIDENT/PROVOST *J. Mad...*

REGISTRAR

DATE APPROVED COURSE DESCRIPTION RECEIVED 4 June 97

HE TAXONOMY AND COURSE NUMBER ASSIGNED 0906-310

DATE/SIGNATURE OF REGISTRAR B. F. Kelly

NOTIFICATION FORWARD:

SENATE CURRICULUM COMMITTEE CHAIRPERSON

DEPARTMENT CHAIRPERSON(S)

ACADEMIC DEAN(S)

REGISTRAR

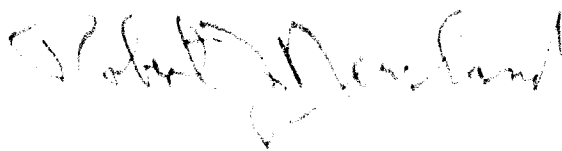
SPONSOR(S)

# ROWAN

Department of Chemistry and Physics  
609/256-4855

To: Curriculum Committee  
From: Robert Newland, Chairperson  
Subject: Chemical Engineering Thermodynamics  
Date: April 9, 1997

I have examined this course proposal which contains much content related to chemistry and find it to be an excellent treatment of the topic. The preparer's qualifications are well known to me and collaboration between the Departments of Chemistry and Physics and Chemical Engineering have been extensive on this matter. The course has our complete support.

A handwritten signature in black ink that reads "Robert Newland". The signature is written in a cursive style and is positioned to the right of the main text block.

## Course Proposal

### 1. Details:

- a. **Course Title:** Chemical Engineering Thermodynamics
- b. **Sponsors:** Dr. Z. Otero Keil  
School of Engineering Curriculum Committee
- c. **Credit Hours:** 3 s.h.
- d. **Course Level:** Junior
- e. **Prerequisites:** Chemical Process Principles II
- f. **Suggested Time/** Spring 1999  
**Scale of** 1 Section to be offered every Spring  
**Implementation:**
- g. **Curricular Effect:** Major Requirement. Course will not affect other course offerings in the School of Engineering
  
- h. **Resources:** Faculty are available to teach the course. No resources beyond those already approved for the engineering building will be required.
  
- i. **Recommended Library Resources:** Engineering journals will be available in the School of Engineering. Journals and books will be acquired consistent with the School of Engineering multi-year budget. References such as those listed below will be used.  
*Chemical Engineering Thermodynamics* by T.E. Daubert  
*Thermodynamics and Its Applications* by J.W. Tester and M. Modell  
*Chemical Engineering Thermodynamics* by S.I. Sandler  
*Introduction to Chemical Engineering Thermodynamics* by J.M. Smith, H.C. Van Ness and M.M. Abbott  
*Chemical Engineering Thermodynamics* by J. Winnick

### 2. Rationale

The proposed course is part of the Engineering Curriculum proposal originally approved by the College Senate in December, 1994. The proposed course is consistent with the establishment of the School of Engineering approved by the Board of Trustees in February, 1995.

The proposed course is a required course for chemical engineering majors and is part of the requirements for accreditation by the Accreditation Board for

Engineering and Technology (ABET) and the Education and Accreditation Committee of the American Institute of Chemical Engineers (AIChE).

The course will be students' first exposure to the theory and application of thermodynamic principles from an engineering perspective. The course will provide a strong foundation for the engineering transport processes courses which are also required for ABET accreditation. The material in the proposed course is not covered in any other course within the School of Engineering available to chemical engineering students. The proposed course builds on the foundation material included in Physical Chemistry I and Chemical Process Principles II.

### **3. Essence of the Course**

#### **a. Objectives of the Course:**

Upon completion of the proposed course, students will understand

- thermodynamic properties of fluids and be able to use thermodynamic tables to obtain properties and solve problems
- the thermodynamics of flow processes, power production, refrigeration and liquefaction
- concepts in solution thermodynamics theory and applications
- equilibria and the stability of phases
- chemical reaction equilibria
- relevance and importance of thermodynamics in engineering theory and applications

Students will also be able to work in teams to synthesize and solve open-ended, complex problems.

#### **b. Topical Outline**

1. Introduction and Review of Basic Thermodynamic Principles
  - Basic Concepts
  - First law of Thermodynamics
  - Volumetric Properties
2. Heat Effects
  - Sensible Heat Effects
  - Internal Energy of Ideal Gases
  - Latent Heats of Pure Substances
  - Standard Heats of Reaction, Formation and Combustion
  - Heat Effects of Industrial Reactions

3. The Second Law of Thermodynamics
  - Statement of the Second Law
  - Heat Engines
  - Thermodynamic Temperature Scales
  - Thermodynamic Temperature and the Ideal-Gas Scale
  - Entropy and Entropy Changes of an Ideal Gas
  - Mathematical Statement of the Second law
  - The Third Law of Thermodynamics
  
4. Thermodynamic Properties of Fluids and Flow Processes
  - Property Relations for Single Phase systems
  - Residual Properties
  - Two-Phase and Multi-Phase Systems
  - Thermodynamic Properties Diagrams and Tables
  - Generalized Property Correlations for Gases
  - Equations of Balance
  - Duct Flow of Compressible Fluids
  - Expansion and Compression Processes
  
5. Solution Thermodynamics Theory and Applications
  - Fundamental Property Relation
  - Chemical Potential
  - Partial Properties
  - Ideal Gas Mixtures
  - Fugacity and Fugacity Coefficients
  - Generalized Correlation for Fugacity Coefficient
  - The Ideal Solution
  - Excess Properties
  - Behavior of Excess Properties of Liquid Mixtures
  - Complexion, Hydrogen Bonding and Other Mixture Phenomena
  - Liquid-Phase Properties from Vapor/Liquid Equilibrium Data
  - Models for Excess Gibbs Energy
  - Property Changes of Mixing
  - Heat Effects of Mixing Processes
  - Molecular Basis for Mixture Behavior
  
6. Phase Equilibria
  - Equilibrium and Stability
  - Liquid/Liquid Equilibrium
  - Vapor/Liquid/Liquid Equilibrium
  - Solid/Liquid Equilibrium
  - Solid/Vapor Equilibrium
  - Equilibrium Adsorption of Gases on Solids
  - Molecular Simulation of Vapor/Liquid Equilibrium

7. Chemical Reaction Equilibria
  - The Reaction Coordinate
  - Application of Equilibrium Criteria to Chemical Reactions
  - The Equilibrium Constant and its Evaluation
  - Relationship between Equilibrium Constant and Composition
  - Phase Rule and Duhem's Theorem for Reacting Systems
  - Multireaction Equilibria
  
8. Power, Refrigeration and Liquefaction
  - The Steam Power Plant
  - Internal Combustion Engine
  - Otto and Diesel Engines
  - Gas-Turbine Power Plant
  - Carnot Refrigeration Cycle
  - Vapor-Compression Cycle
  - Comparison of Refrigeration Cycles
  - Refrigerants
  - Absorption Refrigeration
  - The Heat Pump
  - Liquefaction Processes
  
9. Thermodynamic Analysis of Processes
  - Calculation of Ideal Work
  - Lost Work
  - Thermodynamic Analysis of Steady-State Flow Processes

**c Evaluation and Grading Procedures of Students**

Students will be graded on the basis of performance in examinations, homework, and projects. A course syllabus with the details of the grading procedure will be distributed to students and discussed during the first week of class.

**d. Course Evaluations**

The proposed course will be evaluated on the basis of student evaluations and curriculum review by appropriate faculty and the School of Engineering Curriculum Committee.

#### **4. Results of Consultations**

The proposed course is part of the Engineering Curriculum Proposal approved by the Senate in December, 1994. Consultations were submitted with the original proposal as specified by the Senate Curriculum Committee.

Dr. Robert Newland and Dr. Lee Dinsmore of the Department of Chemistry and Physics were consulted. Dr. Newland is Chairperson of the Department of Chemistry and Physics and Dr. Dinsmore teaches related courses. Both Drs. Newland and Dinsmore were very supportive. Dr. Newland's letter of support is attached. No other programs contain directly related courses.

## **Catalog Description**

Chemical Engineering Thermodynamics

0906.310

Prerequisite: Chemical Process Principles II

This course provides a foundation in engineering thermodynamic principles. The course includes an overview of basic thermodynamic principles, heat effects, the Second Law of Thermodynamics and thermodynamic properties of fluids and flow processes. The course will also include solution thermodynamics theory and application, phase equilibria, chemical reaction equilibria, power and refrigeration cycles, liquefaction and thermodynamic analysis of processes. The course will focus on the synthesis and solution of complex problems in a team project-oriented environment.

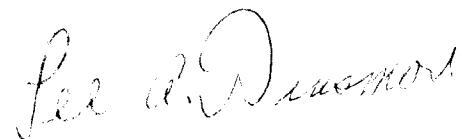
# ROWAN

April 11, 1997

Dr. Zenaida Otero Keil  
Chemical Engineering Department

Dear Dr. Keil:

I have read your proposal for the course, Chemical Engineering Thermodynamics. I think that the proposed course of study is thorough and comprehensive and will be very valuable for engineering students.

A handwritten signature in cursive script, reading "Lee A. Dinsmore".

Lee A. Dinsmore  
Professor of Chemistry