ESF Course Proposal Form
Committee on Instruction - ESF Faculty Governance
Office of Instruction & Graduate Studies

Date: March 7, 2013
Course Number: PSE 370
Course Title: Principles of Mass and Energy Balances

☐ New Course  OR  ☑ Changes in existing course (check all that apply):

☐ Prefix  ☑ Description  ☐ Shared Resources
☐ Number  ☐ Pre-requisite(s)  ☐ Course Format
☐ Credits  ☐ Co-requisite(s)  ☐ Content
☐ Title  ☐ Semester Offered

For new courses only, indicate if you would like approval as a course meeting the General Education standards in the following knowledge and skills area (check all that apply):

☐ American History  ☐ Humanities  ☐ Other World Civilizations
☐ The Arts  ☐ Mathematics  ☐ Social Sciences
☐ Basic Communication  ☐ Natural Sciences  ☐ Western Civilization

If changing an existing course, describe the change(s):
- Change in the student learning outcomes to clarify specifically what is covered

List any pre- or co-requisites here: PHY 211, MAT 296 (or concurrent), FCH 152

Institutional Impact:
Anticipated Enrollment: 30-40 per semester

Technology and Classroom Resource Demands: Course requires a classroom with white/black boards and computer and computer projection system with PowerPoint.

Computing Resources: The course requires the following software to be available to the students in the computer laboratories: Matlab, Mathcad, Excel, Word. Blackboard software.

Library Resources: Course reserve material will be provided to library staff if needed.

Transportation Requirements: N/A

Forest Properties or Field Practicum Facilities Required: Gateway Building CHP plant may be used for mass and energy balance calculation.

Proposer Contact Information:
Name: Gary M Scott  Department: PBE
Health and Safety Considerations:

Conditions or situations present in association with the course?

Yes / No

1. Will substances with any of the following properties be used during instruction: flammability, toxicity, corrosivity, reactivity, registered pesticide, legally controlled, or other characteristics with the potential to cause harm or injury? No

2. Will any physical hazards be present during instruction? (e.g., machines that need safety guards; razor blades or syringes; compressed gases, etc.) No

3. Will any biological hazards be present during instruction? (e.g., handling animals (rabies or hantavirus); cultures or stocks of infectious agents (fungal spores, viruses, bacteria, etc.).) No

4. Will any radiation hazards be present during instruction? (e.g., radioisotopes, X-rays, ultraviolet rays, lasers, etc.). No

5. Will any electrical equipment that, due to its design, location, or method of use, pose any threat to safety during instruction? (Give considerable thought to electrical use outdoors, or any potentially wet location.). No

6. Will there be any personal safety issues related to the class? (e.g., due to time of day or location, at the end of any organized class exercise, will students be in danger of physical assault, etc.). No

7. Will any students be driving official state or research sponsored land or water vehicles during any class or instructional exercise? No

8. Will any type of personal protective equipment be necessary during class exercises? (e.g., hard-hats, eye/face protection, hearing protection, hand/foot protection, lab coat, visibility clothing, etc.) No

If the answer was “Yes” to any of the HEALTH AND SAFETY questions, please explain:

A detailed course description must accompany the Course Proposal Form
DETAILED COURSE DESCRIPTION

COURSE: PSE 370 – Principles of Mass and Energy Balances
3 Credit Hours – Fall Semester
3 Hours Lecture Per Week
Prerequisite(s): PHY 211, MAT 296 (or concurrent), FCH 152

SCOPE:

1. **Level of Instruction:**
   a. PSE 370 is a sophomore/junior level class required of all PBE undergraduates.

2. **Relation to curriculum or to other ESF or Syracuse University courses:**
   a. This course is an introductory course to Chemical Engineering Principles.
   b. Shared resource requirements: PSE 570

3. **This course is the introductory course in the engineering sequence of courses in the paper engineering, bioprocess engineering, and paper science programs. In addition, students in the engineering track of the environmental science program also take the course.**

**STUDENT LEARNING OUTCOMES:**

After completing this course the student should be able to:

1. Explain the concepts of dimensions, units, psychrometry, steam properties, and conservation of mass and energy;
2. Solve steady-state mass and energy balance problems involving multiple process units and recycle/bypass/purge streams;
3. Solve and understand simple unsteady-state mass and energy balances;
4. Assess the quality and quantity of data given in engineering problems and discuss the quality of the solutions derived from the data given;
5. Solve more complicated problems using the software appropriate to the problem;
6. Present the solutions to engineering problems in both oral and written form in a clear and concise manner.

**MAJOR CONCEPTS OR METHODOLOGIES:**

The course is designed as an introduction to engineering calculations and problem solving. These are skills used in many of the upper division paper, bioprocess, and environmental engineering courses, summer and co-op jobs, and in the students’ future careers. For example in PSE 468, students will be doing mass and energy balances on the paper machines in the pilot plant during the senior papermaking runs. In the senior design courses (PSE 481 and BPE 481) students will be doing engineering calculations to validate your design. In addition to learning how to solve engineering problems with pencil, paper, and calculator, students will also be doing computer solutions using WinGems (a pulp and paper industry-specific simulator), MathCad, Matlab, and Excel. A familiarity with some of these software packages will help students with this class and in future classes. Developing the skill to solve complicated mass and energy balance problems will make the topics covered in future classes much easier to learn.

The course covers the material that is typically covered in a mass and energy balances course in a traditional chemical engineering program. However, examples are taken from the paper industry and the broader bioprocess engineering industry. Specifically, the following topics are specifically covered:

1. Basic engineering concepts
   a. Chemistry, physics, and mathematics
   b. Units & dimensions
c. Measurement methods (concentration, composition)
d. Stoichiometry
e. Ideal gas law
f. Mass & mole fraction
g. Temperature
h. Pressure
i. Real gas behavior

2. Physical property relationships
   a. Vapor pressure
   b. Energy concepts
   c. Humidity
d. Heat capacity
   e. Steam tables

3. Systems and basic mass and energy balances
   a. Steady-state mass balances
   b. Conservation of mass
c. Conservation of energy
d. Problem solving
e. Degrees of freedom

4. Problem solving and advanced balances
   a. Multiple process systems
   b. Humidification
c. Reactive systems
d. Combustion
e. Unsteady state balances

5. Computer solutions to mass and energy balances
   a. Basic mass balances
      i. Excel
      ii. Mathcad
   b. Advanced mass balances and simulation
      i. WinGems
      ii. Superpro Designer
      iii. ChemCAD
      iv. Matlab w/Simulink

The course covers the material primarily in a traditional lecture format. Homework is utilized to provide students with practice on the problem solving techniques that are covered in class. In addition, students are expected to complete an open-ended design project involving mass and energy balances around a more complicated reactive system. During the course, students will develop a working knowledge of mass and energy balances and the tools necessary to effectively solve engineering problems. Students will work on group projects that will incorporate the concepts learned in the course.

CATALOG DESCRIPTION (Please provide using the precise format to be included in the ESF catalog, please do not exceed 1000 characters)

PSE 370 Principles of Mass and Energy Balance 3 credit hours

Three hours of lecture per week. Conservation of mass and energy applied to steady-state and dynamic process units and systems. Problem analysis and solution; computational techniques. Thermodynamic data and their use; real vs. perfect gases; steam properties; psychrometry. Fall.

Pre- or co-requisite(s): PHY 211, MAT 296 (or concurrent), FCH 152

COURSE HISTORY:
This course was approved by the C of F Faculty on 10/5/66 under the number POP 101. By the Faculty Action of 5/7/68 it was renumbered PSE 570, effective 9/1/68. PSE 570 was renumbered PSE 370 by the Faculty Action of 12/19/73, which approved the renumbering of many 500-level courses to conform to SUNY standards. Minor change 8/27/75. Course revised by Faculty Action of 3/26/81. Prerequisites updated on 9/16/99. Course updated on 2/18/13.

Revised Draft: 2/18/13 (form in protected format: 3/7/13)