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

Date: December 10, 2012
Course Number: BPE 510
Course Title: Introduction to Polymer Coatings

X 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):

________________________________________________________________________________________________________________________________________________________

List any pre- or co-requisites here:  B.S. from an accredited institution with at least one semester of organic chemistry or permission of instructor.

Institutional Impact:

Anticipated Enrollment: 15 students per semester

Technology and Classroom Resource Demands: This is an online course.

Computing Resources: Blackboard course management system
Adobe Presenter

Library Resources:

Transportation Requirements:

Forest Properties or Field Practicum Facilities
Required:

Proposer Contact Information:
Name: Dr. Chuck Spuches      Department: ESF Outreach
Email: cspuches@esf.edu      Phone: 6810

Chair/Coordinator Signature:
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?  

N

2. Will any physical hazards be present during instruction? (e.g., machines that need safety guards; razor blades or syringes; compressed gases, etc.).  

N

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.).  

N

4. Will any radiation hazards be present during instruction? (e.g., radioisotopes, X-rays, ultraviolet rays, lasers, etc.).  

N

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.).  

N

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.).  

N

7. Will any students be driving official state or research sponsored land or water vehicles during any class or instructional exercise?  

N

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.)  

N

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: BPE 510 / Introduction to Polymer Coatings
3 Credit Hours - Academic Year and/or Summer Session
Online
Prerequisite(s): B.S. from an accredited institution with at least one semester of organic chemistry or permission of instructor.

SCOPE:

1. Level of Instruction:
   a. BPE 510 is one of three courses in a Radiation Curing Technologies course suite. This graduate-level course focuses on a specialized application of chemistry.

2. Relation to curriculum or to other ESF or Syracuse University courses:
   a. BPE 510 is part of the biomaterials graduate program option within the Paper and Bioprocess Engineering academic department.
   b. BPE 510 is available as an elective course within all graduate curricula at ESF and Syracuse University.
   c. Shared resource requirements: NA

LEARNING OUTCOMES:

After completing this course participants will be able to:

Materials Properties
1. Describe cross-linking polymerization reactions and film formation.
   A. Recognize synthetic polymers through their molecular weight and constituent compounds.
   B. Describe thermoplastic and thermosetting polymers and their critical attributes.
   C. Classify thermoplastic and thermosetting polymers based on their distinguishing characteristics.

2. Describe the mechanical properties of polymer films and their relationship on performance.
   A. Describe rheology, elasticity, thermal effects, abrasion resistance, and adhesion.
   B. Describe the process for appropriately measuring properties associated with rheology, elasticity, thermal effects, abrasion resistance, and adhesion.
   C. Specify how film properties are altered through the use of binders and additives.
   D. Predict the impact of various conditions during polymerization on film properties.

Chemistry of Industrial Polymers
3. Describe how binders are synthesized.
   A. Explain how the selection of constituent compounds and processing conditions result in specific polymer types.
   B. Describe the polymerization reactions that occur to create acrylic resins, latexes, polyester resins, amino resins, epoxy resins, alkyd resins, and silicon derivatives.
C. Describe the advantages and disadvantages of selected polymers with respect to their end-use.

4. Describe how to measure film qualities and limit defect formation during polymerization.
   A. Explain how various defect types are introduced into a film.
   B. Predict a defect’s effect on desired properties.

**Coatings for Industrial Applications**

5. Compare and contrast methods for coating a polymer onto a substrate.
   A. Determine solubility limits and volatility to select solvents that are safe for use with both binders and substrates.
   B. Describe the basic principles involved in curing, including solvent evaporation and setting of the binder.
   C. Match equipment with selected polymer and substrates combination in order to create continuous solid coatings.

6. Describe the applications of specific coatings.
   A. Assess the benefits of tailoring surface properties to enhance a product’s usability, lifetime, and aesthetic appeal.
   B. Propose how to use polymer coatings to create or enhance new products.

**MAJOR CONCEPTS OR METHODOLOGIES:**

This course provides the scientific foundation to polymer synthesis and their formulation as a coating. Course content applies to post-baccalaureates and professionals, and is intended to further understanding of current technologies and techniques at use in the coatings industry.

The coatings industry is advancing technologically, punctuated by an increase in the use of radiation curing as a way of saving energy while providing a uniformly hardened coating on many different substrate materials. While well-established in research and development settings as well as in certain manufactured product groups, uptake of this technology has been limited by the diffusion of technical knowhow.

This course seeks to educate product development scientists and engineers, equipment operators, project managers and other relevant industry professionals on the fundamental science involved in polymerization and film formation for a wide class of organic coatings, including acrylics, latexes, polyesters, amino resins, epoxies, alkyds, and silicon derivatives. Different reaction chemistries and their distinguishing characteristics will be discussed for several cross-linking agents. The kinetics of these systems will also be considered, with an emphasis on the influence of the conditions during synthesis.

This course entails examination of the characterization of coatings through their desired mechanical and optical properties, as well as the selection of appropriate binders and additives affecting the quality of the coatings. An understanding of the nature of defects and the resulting effect on product lifetime will also be introduced. Lastly, this course will highlight selected specific applications of coatings.

Required course readings and learning activities are support relevant and useful preparation in the underlying science of polymer coatings for those working in this field and those aspiring to enter this field.
CATALOG DESCRIPTION (Please provide using the precise format to be included in the ESF catalog, please do not exceed 1000 characters)

BPE 510 / Introduction to Polymer Coatings (3)
Fundamental science of polymerization and film formation for a wide class of organic coatings, including acrylics, latexes, polyesters, amino resins, epoxies, alkyds, and silicon derivatives as well as the integration of appropriate binders and additives affecting coating quality. Reaction chemistries and their distinguishing characteristics for several cross-linking agents. Reaction kinetics are considered with emphasis on the influence of conditions during synthesis. Various organic coatings are compared based on desired mechanical and optical properties along with specific applications. The nature of defects and the resulting effect on product lifetime of coatings are examined. Online Academic Year and/or Summer Session.

Prerequisite(s): B.S. from an accredited institution with at least one semester of organic chemistry or permission of instructor.

COURSE HISTORY:
This is a new course.
Last approved: NA.
Revised Draft: December 7, 2012