Glassboro State College Senate Curriculum Committee

Approval Form

Proposal Title: Polymer Characterization 1907.478

Sponsor(s) Newland Dept.: Physical Sciences ☎Ext. 6337

Dinsmore, Schultz 7348

Check one: ☒ Course ☐ Specialization ☐ Concentration ☐ Minor ☐ Achievement Certificate

☐ Certification Program ☐ Major Program ☐ Minor Change _____ (please name deletion or credit/title/catalog change)

☒ Undergraduate ☐ Graduate 4 Credit Hours

Step 1 (Department)

☒ Approved [signature] Date

☐ Not Approved [signature] Dept. CC Chairperson

☐ Reviewed 10/18/90 Date

[signature] Dept. Chairperson

Step 2 (Receipt)

☒ SCC# 90-91-6

Proposal Received _____ Date

RECEIVED OCT 18 1990 GLASSBORO STATE COLLEGE

Donna Hathaway SCC Chairperson

Step 3 (School CC)

Reviewed 2/6/91

☒ Approved

☐ Not Approved

Comments:

[signature] School Curr. Comm. Chairperson

Step 4 (Academic Dean)

☐ Recommend

☐ Not Recommend

☐ Conditionally Recommend (see comments)

Reviewed Feb 6, 1991 Date

Comments:

[signature] Signature, Dean of School

Step 5 (SCC)

Open Hearing 3/5/91 Date

☒ Approved by Senate Curriculum Committee 3/5/91 Date

☐ Returned to sponsor(s) for the following reasons:

Step 6 (Senate)

Presented to Senate 3/26/91 Date

☒ Approved ☐ Not Approved

Notification to Executive Vice-President/Provost 3/26/91 Date

[signature] Signature, SCC Chairperson

Step 7 (Executive V.P./Provost)

Received 3/28/91
Date

Approved ☐ Yes ☐ No

If no, reasons are as follows:

Student credit hours 4

Faculty load hours 5

Equalized credit hours 4 1/3

Official copy and approval sheet filed APR. 26 1991
Date

Signature, Executive ~~Vice President/Provost~~

Registrar

Approved course description received 22 April '91
Date

Hegis Taxonomy and Course Number assigned 1907.478

B Z Kelsey
Signature, Registrar

22 April '91
Date

Notification forwarded:

- ☐ Senate Curriculum Committee Chairperson
- ☐ Department Chairperson(s)
- ☐ Academic Dean(s)
- ☐ Registrar
- ☐ Sponsor(s)

COURSE PROPOSAL

DETAILS

COURSE TITLE: Polymer Characterization

SPONSORS: Drs. Robert Newland, Lee Dinsmore and Charles Schultz

CREDIT HOURS: 4 (includes laboratory)

COURSE LEVEL: Junior/Senior

CURRICULAR EFFECT: Elective

PREREQUISITES: Organic Chemistry II, Physical Chemistry I, Polymer Synthesis (New course)

SUGGESTED TIME AND SCALE OF IMPLEMENTATION: First offering in the Fall term of 1991

ADEQUACY OF PRESENT STAFF, RESOURCES, LIBRARY HOLDINGS, SPACE AND EQUIPMENT: Faculty, resources and space are adequate. Library holdings are improving in this subfield of chemistry. Equipment is adequate although additional instrumentation is being sought.

The course topics are primarily in the area of organic chemistry. Supporting topics are in the subfield of physical or analytical chemistry. These are the areas of specialization of the sponsors and proposed instructors.

Resources needed include readily available chemicals and glassware. Other general equipment is on hand. Special instrumentation has been purchased for this course over the last four years.

The laboratory component will be housed in the recently renovated lab space available on the third floor of Bosshart. This space can safely house twelve students. Additional lab space is available if needed.

Many of the books purchased in the past three years by the library for the department have been in the field of polymer chemistry.

SHORT TERM EVALUATIONS

This course has not been offered under the short-term process but we have offered another similar course entitled "Introduction to Polymer Chemistry." Last year this course was offered with a laboratory section for the first time by offering a special section of our Seminar II course. Ten students enrolled. In the Fall term of 1987 we offered the "Introduction to Polymer Chemistry" without the lab and thirteen were enrolled. The students in each were laudatory of the course. They performed above the national average on the American Chemical Society Standardized Test for

Polymer Chemistry. It is our intent to discontinue this course in the future.

RATIONALE

The BS in Chemistry offered by the Department of Physical Sciences is accredited by the American Chemical Society (ACS). Polymer chemistry is one of the three advanced topics recommended by the ACS. It has been estimated by several organizations including the ACS that one-third to one-half of all chemists eventually work in polymer chemistry. Recently the Polymer Chemistry Division Curriculum Task Force and the ACS Education Committee recommended a preliminary topics list for offerings in this field to receive a concentration designation within the regular BS Degree program. We are interested in following these guidelines closely in our own offerings.

We view this course as part of our total offerings in the polymer chemistry area. A second, companion course entitled "Polymer Synthesis" is being simultaneously proposed and it is a prerequisite to this course.

ESSENCE OF THE COURSE

a. Objectives

Students taking this course will be able to:

1) discuss the generalized methods for the characterization of common polymers.

2) discuss the theoretical considerations of common characterization techniques.

3) read past and current polymer chemistry articles and monographs with understanding and correct analysis of the data contained therein.

4) perform common characterization procedures for polymers.

5) make a positive contribution when employed as a polymer chemist.

b. Topical outline

The following outline summarizes the course contents in the discussion portion of the course.

I. Introduction: Physical aspects of chains and averages of polymers
   - A. Molecular size and shape
   - B. Fractionation
   - C. Molecular weight and characterization methods
   - D. Major polymer characterization techniques

II. Polymer solutions
   - A. Solubility and solubility parameters
   - B. Thermodynamics
   - C. Diffusion

D. Polymer-polymer miscibility

III. Bulk properties
- A. Amorphous/crystalline phases
- B. Destructive and nondestructive characterization methods
- C. Fracture behavior
- D. Thermal transition
- E. Surface and frictional properties

IV. The glass-rubber transition
- A. Five regions of viscoelasticity
- B. Theories of glass transition
- C. Measurement of glass transition temperature
- D. Dynamic mechanical behavior

V. Rubber elasticity
- A. Thermodynamic equation of state
- B. Statistical thermodynamics of rubber elasticity
- C. Internal energy effects

VI. Rheology
- A. Chain diffusion
- B. Viscoelastic behavior
- C. Deformation and stress-strain properties of solids
- D. Melt-rheology
- E. Creep and stress relaxation

VII. Polymer processing
- A. Major conversion techniques
- B. Effect of processing variables

VIII. Measurable properties of polymeric articles

The laboratory portion of this course will vary some from year to year as we try out new experiments. There is no lack of lab texts nor experiments to select from. Typical examples of the possible experiments are as follows.

1) Identification of polymers by infrared spectroscopy
2) Dilute solution viscometry
3) Molecular weight determination by gel permeation chromatography
4) Thermal analysis
5) Polymer fractionation
6) Polymer tacticity by NMR analysis
7) X-ray diffraction by polymers
8) Swelling of network polymers

c. Evaluation and grading procedures

Three major exams will be administered during the semester. The third test, the final exam, will be the ACS Standardized Test for Polymer Chemistry. Weekly problem sets will be required. Each student will be required to read, summarize and analyze two articles from the polymer literature. The summaries and analyses will be

distributed to the entire class. If time permits (this will depend on total enrollment) each student will present one of the articles orally to the class. The exams will be worth 50% of the total grade. The problem sets will constitute 15%, the summaries and analyses will be worth 10% and the lab will be 25% of the total grade.

d. Course evaluation

Student evaluations will be performed at each offering of this course. The content of the course will automatically undergo scrutiny by the American Chemical Society when our program undergoes its annual review. An extensive review of the program's content undergoes an in-depth review by the ACS every five years as well.

In addition, we have in place a Learning Outcomes Assessment Plan approved by the College. This course will be part of that review process. Objective five above will be evaluated by this Assessment Plan.

RESULTS OF CONSULTATION

This course is an upper level course with six semester courses of chemistry prerequisites. It is expected that only physical science and chemistry majors will enroll. Therefore no other department has been consulted.

ADDITIONAL INFORMATION

Because of the importance of this topic in industry there are numerous texts that might be used for the discussion and for the lab portion of this course. The following is a partial list of such texts.

Discussion texts

1) Allcock, Harry R., and Lampe, Frederick W., "Contemporary Polymer Chemistry," 2nd edition, Prentice Hall, Englewood Cliffs, NJ, 1990.

2) Billmeyer, Fred W., Jr., "Textbook of Polymer Chemistry," 3rd edition, New York, NY, 1984.

Laboratory texts

1) Pierce, Eli M., Wright, Carl E. and Bordoloi, Binoy K., " Laboratory Experiments in Polymer Synthesis and Characterization," Educational Module for Materials Science and Engineering Project, University Park, PA, 1982.

2) Collins, Edward A., Bares, Jan, and Billmeyer, Fred W. Jr., "Experiments in Polymer Science," Wiley-Interscience, New York, 1973.

CATALOG DESCRIPTION FOR POLYMER CHARACTERIZATION
(Prerequisites: Organic Chemistry II, Physical Chemistry I, Polymer Synthesis)

This course provides an in-depth study of the procedures, techniques and theoretical aspects of polymer characterization. Major topics include molecular weight determinations, polymer solutions, viscoelasticity and bulk properties.The laboratory experiments will provide exposure to representative procedures and techniques with emphasis on molecular weight determination and thermal methods.

(2)

Glassboro State College Senate Curriculum Committee

Approval Form

Proposal Title: Polymer Synthesis

Sponsor(s) Newland Dept.: Physical Sciences ☎Ext. 6337

Dinsmore, Schultz 7348

Check one: ☒ Course ☐ Specialization ☐ Concentration ☐ Minor ☐ Achievement Certificate

☐ Certification Program ☐ Major Program ☐ Minor Change _____
(please name deletion or credit/title/catalog change)

☒ Undergraduate ☐ Graduate 4 Credit Hours

Step 1 (Department)

☒ Approved _____ Date

☐ Not Approved

_____ Dept. CC Chairperson

☒ Reviewed _____ Date

_____ Dept. Chairperson

Step 2 (Receipt)

☑ SCC# 90-91-5

Proposal Received _____ Date

RECEIVED

OCT 18 1990

CALDWELL STATE COLLEGE
GLASSBORO, N.J.

Donna Hathaway
SCC Chairperson

Step 3 (School CC)

Reviewed 2/6/91

☒ Approved

☐ Not Approved

Comments:

_____ School Curr. Comm. Chairperson

Step 4 (Academic Dean)

Comments:

☑ Recommend

☐ Not Recommend

☐ Conditionally Recommend (see comments)

Reviewed _____ Date

_____ Signature, Dean of School

Step 5 (SCC)

Open Hearing 3/6/91 Date ☑ Approved by Senate Curriculum Committee 3/6/91 Date

☐ Returned to sponsor(s) for the following reasons:

Step 6 (Senate)

Presented to Senate 3/13/91 Date ☑ Approved ☐ Not Approved

Notification to Executive Vice-President/Provost 3/20/91 Date

_____ Signature, SCC Chairperson

Step 7 (Executive V.P./Provost)

Received 3/28/91
Date

Approved ☐ Yes ☐ No

If no, reasons are as follows:

Student credit hours 4

Faculty load hours 5

Equalized credit hours 4 1/3

Official copy and approval sheet filed APR. 26 1991
Date

Signature, Executive Vice President/Provost

Registrar

Approved course description received 22 april '91
Date

Hegis Taxonomy and Course Number assigned 1907.475

B F Kelsey
Signature, Registrar

22 april '91
Date

Notification forwarded:

- ☐ Senate Curriculum Committee Chairperson
- ☐ Department Chairperson(s)
- ☐ Academic Dean(s)
- ☐ Registrar
- ☐ Sponsor(s)

Rev 8/88 8007

COURSE PROPOSAL

DETAILS

COURSE TITLE: Polymer Synthesis

SPONSORS: Drs. Robert Newland, Lee Dinsmore, Charles Schultz

CREDIT HOURS: 4 (includes laboratory)

COURSE LEVEL: Junior/Senior

CURRICULAR EFFECT: Elective

PREREQUISITES: Organic Chemistry II, Physical Chemistry I

SUGGESTED TIME AND SCALE OF IMPLEMENTATION: First offering in the Fall term of 1991

ADEQUACY OF PRESENT STAFF, RESOURCES, LIBRARY HOLDINGS, SPACE AND EQUIPMENT: Faculty, resources and space are adequate. Library holdings are improving in this subfield of chemistry. Equipment is adequate although additional instrumentation is being sought.

The course topics are primarily in the area of organic chemistry. Supporting topics are in the subfield of physical or analytical chemistry. These are the areas of specialization of the sponsors and proposed instructors.

Resources needed include readily available chemicals and glassware. Other general equipment is on hand. Special instrumentation has been purchased for this course over the last four years.

The laboratory component will be housed in the recently renovated lab space available on the third floor of Bosshart. This space can safely house twelve students. Additional lab space is available if needed.

Many of the books purchased in the past three years by the library for the department have been in the field of polymer chemistry.

SHORT TERM EVALUATIONS

This course has not been offered under the short-term process but we have offered another similar course entitled "Introduction to Polymer Chemistry." Last year this course was offered with a laboratory section for the first time by offering a special section of our Seminar II course. Ten students enrolled. In the Fall term of 1987 we offered the "Introduction to Polymer Chemistry" without the lab and thirteen were enrolled. The students in each were laudatory of the course. They performed above the national average on the American Chemical Society Standardized Test for Polymer Chemistry. This introductory course will be discontinued in the near future

RATIONALE

The BS in Chemistry offered by the Department of Physical Sciences is accredited by the American Chemical Society (ACS). Polymer chemistry is one of the three advanced topics recommended by the ACS. It has been estimated by several organizations including the ACS that one-third to one-half of all chemists eventually do work in polymer chemistry. Recently the Polymer Chemistry Division Curriculum Task Force and the ACS Education Committee recommended a preliminary topics list for offerings in this field to receive a concentration designation within the regular BS Degree program. We are interested in following these guidelines closely in our own offerings.

We view this course as part of our total offerings in the polymer chemistry area. A second, companion course entitled "Polymer Characterization" is being simultaneously proposed. This course is prerequisite to the other.

ESSENCE OF THE COURSE

a. Objectives

Students taking this course will be able to:

1) discuss the generalized methods for the synthesis of common polymers.
2) discuss the theoretical considerations of the mechanisms including the kinetics of step-growth and chain-growth polymerizations.
3) read past and current polymer chemistry articles and monographs with understanding and correct analysis of the data contained therein.
4) perform common synthetic procedures for polymers.
5) make a positive contribution when employed as a polymer chemist.

b. Topical outline

The following outline summarizes the course contents in the discussion portion of the course.

I. Introduction
    A. Basic features of polymeric materials
    B. Types of polymers
II. Chain-growth polymerizations
    A. Homopolymers
    B. Copolymers
    C. Synthetic techniques
    D. Kinetics
III. Polymers with microstructure
IV. Step-growth polymerizations
    A. AA-BB and AB condensations
    B. Ring opening polymerizations
    C. Hydrogen transfer polymerizations

D. Synthetic techniques
E. Kinetics

V. Natural polymers
A. Polysaccharides
B. Proteins
C. Nucleic acids
D. Rubbers

VI. Inorganic and organometallic polymers
VII. Chemistry of major monomers and polymer intermediates
VIII. Additives
IX. Technology and processing aspects of major forms of polymeric materials
A. Fibers
B. Elastomers
C. Molding resins
D. Coatings
E. Adhesives

X. Polymer reactions and modifications
XI. Multicomponent systems

The laboratory portion of this course will vary some from year to year as we try out new experiments. There is no lack of lab texts nor experiments to select from. Typical examples of the possible experiments are as follows.

1) Free radical copolymerization of styrene and methyl methacrylate.
2) Free radical polymerization kinetics by dilatometry.
3) Anionic polymerization of styrene.
4) Bulk polymerization of omega-aminoundecanoic acid.
5) Emulsion polymerization of styrene.
6) Preparation of crosslinked polymers.
7) Interfacial polycondensation of diacyl halides and diamines.
8) Ring opening polymerizations.

c. Evaluation and grading procedures

Three major exams will be administered during the semester. Weekly problem sets will be required. Each student will be required to read, summarize and analyze two articles from the polymer literature. The summaries and analyses will be distributed to the entire class. If time permits (this will depend on total enrollment) each student will present one of the articles orally to the class. The exams will be worth 50% of the total grade. The problem sets will constitute 15%, the summaries and analyses will be worth 10% and the lab will be 25% of the total grade.

d. Course evaluation

Student evaluations will be performed at each offering of this course. The content of the course will automatically undergo scrutiny by the American Chemical Society when

our program undergoes its annual review. An extensive review of the program's content undergoes an in-depth review by the ACS every five years as well.

In addition, we have in place a Learning Outcomes Assessment Plan approved by the College. This course will be part of that review process. Objective five above will be evaluated by this process.

RESULTS OF CONSULTATION

This course is an upper level course with four semesters of chemistry prerequisites. It is expected that only physical science and chemistry majors will enroll. Therefore no other department has been consulted.

ADDITIONAL INFORMATION

Because of the importance of this topic in industry there are numerous texts that might be used for the discussion and for the lab portion of this course. The following is a partial list of such texts.

Discussion texts

1) Allcock, Harry R., and Lampe, Frederick W., "Contemporary Polymer Chemistry," 2nd edition, Prentice Hall, Englewood Cliffs, NJ, 1990.

2) Billmeyer, Fred W., Jr., "Textbook of Polymer Chemistry," 3rd edition, New York, NY, 1984.

3) Odian, G., "Principles of Polymerization," Wiley, New York,

Laboratory texts

1) Pierce, Eli M., Wright, Carl E. and Bordoloi, Binoy K., " Laboratory Experiments in Polymer Synthesis and Characterization," Educational Module for Materials Science and Engineering Project, University Park, PA, 1982.

2) Collins, Edward A., Bares, Jan, and Billmeyer, Fred W. Jr., "Experiments in Polymer Science," Wiley-Interscience, New York, 1973.

CATALOG DESCRIPTION FOR POLYMER SYNTHESIS
(Prerequisites: Organic Chemistry II, Physical Chemistry I)

This course provides an in-depth study of the procedures, techniques and theoretical aspects of polymer synthesis. Reaction mechanisms including kinetic and thermodynamic considerations will be studied. The topic of polymer synthesis will be examined from raw material sources through product usage. The laboratory experiments will provide exposure to representative procedures and techniques.