



POLYMER ENGINEERING

GRADUATE STUDENT GUIDEBOOK

www.uakron.edu/dpe/documents/handbook.pdf

August 2020 Edition

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I. MASTER OF SCIENCE IN POLYMER ENGINEERING

A. GENERAL INFORMATION

1. Overview

Polymer Engineering administers a graduate program in which students are guided through a course of study and research under the supervision of a faculty member leading to the award of a Master of Science in Polymer Engineering. Basic requirements of the Graduate School for the master's degree are set forth and described in the current *Graduate Bulletin* (graduate catalog) available from Graduate School or online at <https://bulletin.uakron.edu/graduate/>. Requirements of the Polymer Engineering program are also listed in the *Graduate Bulletin* and are more specifically articulated in this Guidebook. **The combined requirements of the Graduate School and the Polymer Engineering program represent the minimum standards for attainment of the degree.** In an effort to tailor the program to each student's background and research interests, Polymer Engineering and/or the student's advisor may request requirements beyond the minimum in order to ensure academic and professional success.

2. Residency Requirements

There are no formal residency requirements for the master's degree. A student may meet the degree requirements of the Graduate School and Polymer Engineering through either full- or part-time study.

3. Enrollment

A master's student may meet the degree requirements of the Graduate School and Polymer Engineering through either full- or part-time study; however, **any student who intends to use laboratories in the Olson Research Center and/or National Polymer Innovation Center, or facilities in the Polymer Engineering Academic Center must be appropriately enrolled for that term, including summer session.**

4. Time Limit

All requirements for the master's degree must be completed within six (6) years after beginning graduate-level coursework at The University of Akron or elsewhere. An extension of up to one year may be granted in unusual circumstances by the dean of the Graduate School upon written request by the student and recommendation by his/her advisor, the director of the School of Polymer Science and Polymer Engineering, and the college dean.

5. Credits

A minimum of two-thirds of the total graduate credits required in any master's program must be completed at the University.

No graduate credit may be received for courses taken by examination or for 500-numbered courses previously taken at the 400-number course level as an undergraduate without advance approval from the dean of the Graduate School.

Any graduate course may be repeated once for credit. The credit hours and grades of both the original and the repeated course will be used in computing the grade-point average. Required courses in which either a "D" or "F" were received must be repeated. Repeat for change of grade is not available at the graduate level.

It should be noted that it is entirely within the prerogative of Polymer Engineering to assign additional credits of coursework or other requirements in the interest of graduating a fully qualified student.

6. Transfer Work

As of Fall 2019, Polymer Engineering will only allow a maximum of nine (9) credits to be transferred in from an accredited college or university. All transfer credit must be at the "A" or "B" level (4.00 to 3.00) in graduate courses. The credits must be relevant to the student's program as determined by the student's advisor and director of the School of Polymer Science and Polymer Engineering and fall within the six-year time limit.

Transfer credit shall not be recorded until a student has completed his or her first year in polymer engineering at The University of Akron with a grade-point average of 3.00 or better. Transfer credit from other institutions shall not be computed as part of a student's University of Akron grade point average.

7. Advising

Until a student has chosen and been assigned to an advisor, all advising questions and issues will be handled by the director of the School of Polymer Science and Polymer Engineering.

During the Fall term, new students will have an opportunity to hear polymer engineering faculty give a formal presentation on their research. In addition, students are to individually discuss research possibilities with each of the polymer engineering faculty. Students will then be asked to provide Polymer Engineering with several choices, in priority order, of faculty members with whom they would like to work. The faculty then meet as a whole to review the choices after which the student will then be assigned to one faculty member who will serve the student as his/her advisor. Thereafter, the faculty member will direct the student in the completion of the academic and research requirements necessary for successful awarding of the master's degree. Since the student-advisor relationship in a graduate research investigation is a particularly close one, a student should give careful thought to the choice of an advisor.

8. Registration

Registration for classes should only occur after consulting your advisor. The following enrollment rules are currently in effect for master's students:

- a. Full-time master's students will register for 9 credits in each Fall and Spring semester and 1-6 credits in the Summer session.
- b. Part-time master's students must register for a minimum of one credit in each Fall and Spring semester and one credit in the Summer session.

- c. **Students who are close to graduating must have defended their thesis AND been totally cleared by Graduate School to graduate BEFORE the Graduate School deadline in order to be exempt from having to register for a minimum 1 credit in the next term.**

For example, a student takes one (1) credit in the Summer session to finish up but does not defend and upload her finalized thesis to OhioLink in time to meet the deadline set by Graduate School to graduate in August. Therefore, she must register for one (1) credit in Fall and will not graduate until December.

9. DPR - Degree Progress Report

Graduate students are able to track their degree progress and review their academic record by logging into My Akron and accessing their Degree Progress Report (DPR). Students should review their DPR at least once each semester. The DPR report will show all completed and remaining degree requirements. The system may be accessed at any time and will be helpful for planning degree completion. The Graduate School will use the DPR system to review student records prior to graduation; however, it is the responsibility of each graduate student to confirm that she/he has met all degree requirements. As always, you should work closely with your faculty advisor to ensure that you are making adequate progress toward your degree.

10. Leaving the University before Degree Completion

- a. Students who are leaving the polymer engineering program must formally notify both their advisor and the director of the School of Polymer Science and Polymer Engineering.
- b. Students must clean out their workstation and any lab space, turn in all keys, pay any outstanding invoices, fines, or fees, and return any and all borrowed library materials.
- c. If a student is employed with the stipulation of obtaining a master's degree and the employer inquires about the completion of the degree, the employer will be told that the degree is unfinished.

11. Graduation - General

Graduate students must apply for graduation online through My Akron. This online application should be submitted by the following dates:

- April 1 for Spring Commencement
- July 1 for Summer Commencement (no ceremony)
- November 1 for Fall Commencement

Further information regarding graduation and/or responding to attend a commencement ceremony may be found here: <http://www.uakron.edu/registrar/graduation/>.

To be cleared for graduation, a candidate must have completed all coursework with a minimum cumulative graduate grade-point average of at least 3.00; submitted an online application for graduation with the University Registrar; paid all applicable fees; and met any other applicable Polymer Engineering and University requirements.

Final online submission of a properly prepared thesis is due to the Graduate School at least three weeks prior to commencement. This copy must be signed by the adviser, the director of the School of Polymer Science and Polymer Engineering, and the college dean prior to submission to the Graduate School. A manual titled *Guidelines for Preparing a Thesis or Dissertation* is available online and all copies of the thesis must conform to these instructions.

12. Graduation – Polymer Engineering

Within the Polymer Engineering program, to be cleared for graduation a student must have:

- Completed all required coursework and research hours with a minimum cumulative graduate grade-point average of 3.00;
- Filed an Application to Graduate;
- Submitted an approved thesis and passed an oral defense;
- Provided the appropriate number of thesis copies;
- Paid all applicable fees and/or fines;
- Returned all building and office keys to the Lock Shop;
- Returned all library materials;
- Cleaned up all lab space, equipment, glassware, and student workstation;
- Properly labeled and stored or discarded any chemicals or other equipment;
- Completed an Exit Survey form; and,
- Met any other Polymer Engineering and University requirements.

Failure to follow the above procedures may delay your clearance for graduation and transcripts of academic work and degrees may not be sent by the University to employers or other schools.

13. Copies of Final Thesis

A student must provide four copies of his/her thesis as indicated. All four copies require original signature pages:

- One electronic version of the thesis is to be submitted to OhioLINK plus a fully signed signature page sent to Graduate School;
- One hard-bound copy for Polymer Engineering;
- One hard-bound copy for the student's advisor; and,
- One hard-bound copy for the student.

A Master's thesis is to be bound in black hard cover. For further information on thesis submission and binding, please consult the website for the Graduate School at:
<http://www.uakron.edu/gradsch/current-students/gdlnthesdiss.dot>

B. DEGREE REQUIREMENTS

The Master of Science degree is awarded to a student after the completion of a prescribed program of course studies, and a research project that leads to the preparation of a written thesis describing the research in a scholarly manner. A student and his/her advisor can plan any additional courses necessary to solve the thesis research project and/or that allow for the academic and professional growth of the student.

Currently, to achieve the M.S. in Polymer Engineering, a student must successfully complete:

- 30 credits in polymer engineering, including:
 - 12 credits of polymer engineering core courses
 - 6 credits of polymer engineering 600-level electives
 - 6 credits of technical electives
 - 6 or more credits of research
- A written thesis
- An oral defense of the thesis

1. 30 Credits

The minimum 30 credits for the master's degree in polymer engineering are as follows:

- **12 credits of core courses:**

9841:611	Fundamentals of Polymer Structure Characterization	3 credits
9841:621	Rheology of Polymeric Fluids	3 credits
9841:641	Polymer Chemistry and Thermodynamics	3 credits
9841:650	Introduction to Polymer Engineering	<u>3 credits</u>
	Total	12 credits

- **6 credits of polymer engineering 600-level electives:**

To achieve the 6 credits of electives, please choose from the following:

One credit elective

9841:601	Polymer Engineering Seminar	1 credit
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◆ **Note - All M.S. students must register for 9841:601 one time for one credit.**

Two credit electives

9841:631	Engineering Properties of Solid Polymers	2 credits
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Three credit electives

9841:600	Interfacial Phenomena in Soft Matter
9841:610	Polymer Engineering Analysis
9841:622	Analysis and Design of Polymer Processing Operations I
9841:623	Analysis and Design of Polymer Processing Operations II
9841:651	Polymer Engineering Laboratory

◆ **Note - This course requires 9841:622 as a prerequisite.**

9841:661	Polymerization Reactor Engineering
9841:666	Research Methods
9841:675	Carbon-Polymer Nanotechnology
9841:680	Polymer Coatings

Total 6 credits

- **6 credits of technical electives – math, engineering, polymer engineering, or polymer science:**
 - ◆ Course selection(s) to be approved by your advisor.

Please choose from the following:

3450:5XX	Math
3450:6XX	Math
4300:681	Advanced Engineering Materials
4600:622	Continuum Mechanics
9841:610	Polymer Engineering Analysis
9841:666	Research Methods
9841:797	Advanced Topics in Polymer Engineering
9871:613	Polymer Science Laboratory
9871:674	Polymer Characterization
_____	Other technical elective

Total 6 credits

- **6 or more credits of master's thesis research:**

9841:699	Master's Thesis
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Total 6 credits

TOTAL **30 credits**

2. Classes in the First Fall Semester

Classes in the first Fall semester of study for all M.S. students are the same:

9841:621	Rheology of Polymeric Fluids	3 credits
9841:641	Polymer Chemistry and Thermodynamics	3 credits
9841:650	Introduction to Polymer Engineering	<u>3 credits</u>
	Total	9 credits

3. Master's Thesis

a. When to Begin

Master's candidates must complete a research problem approved and guided by his/her advisor. Because the research investigation is so important, students should begin research with their advisor as soon as they have been assigned to one, and certainly before the end of the first semester of graduate study.

b. Written Thesis

The written account of a student's research is known as a thesis. The thesis must exhibit an advanced level of understanding of the principles of polymer engineering and science as developed from lecture courses and specialized research reading. A manual entitled *Guidelines for Preparing a Thesis or Dissertation* is available in the Graduate School or online at:

<http://www.uakron.edu/gradsch/current-students/gdlnthesdiss.dot>

Students should obtain a copy of this at the outset of their writing, as all copies of the thesis must conform to the instructions detailed therein. Once the student has completed a final draft of the thesis, the student and his/her advisor may form a thesis committee and set up the required oral defense.

c. Thesis Committee

The thesis committee is comprised of a minimum three faculty members: the student's advisor and two faculty from the School of Polymer Science and Polymer Engineering. Faculty from other colleges and, in some cases, an outside representative of the student's research project, may serve as additional committee members with the advisor's approval. The advisor and student will jointly choose the committee members based upon each member's research interests, expertise, and availability.

d. Oral Defense

The oral defense is a verbal presentation of a student's thesis research to his/her committee that is also open to the public. The student and committee will establish a mutually agreeable date and time for the oral defense. Students must see the Polymer Engineering office to arrange for a room for the defense and to provide the details and abstract of his/her presentation for public announcement.

- The thesis must be submitted to Polymer Engineering for plagiarism check and approved by the advisor.
- The defense must be publicly posted, and final copies of the thesis submitted to each faculty member on the committee **at least two weeks prior to the actual defense date.**
- Prior to the oral defense, the student should obtain the "Master's Thesis Defense Report" form from the Polymer Engineering webpage <http://www.uakron.edu/dpe/about-us/forms.dot>

Immediately after the defense, the thesis committee members will meet to discuss the thesis and then provide the student with their feedback and any further corrections. This is the last opportunity for a student to obtain a critical review of his/her work before submitting the completed thesis to the Graduate School.

If the candidate does not pass first thesis defense

The committee may allow the student to make a second defense attempt, rewrite the thesis, or both. The committee will define the timeline for completion.

If the candidate does not pass second thesis defense

If a student fails a thesis defense on the second try, he/she will be asked to leave the program.

e. Finalizing the Thesis and Submission of Thesis to Graduate School

After a successful oral defense, the student will:

- Make any required corrections to the thesis as mandated by the committee;
- Obtain the appropriate signatures which include: advisor, co-advisor (if any), committee members, the director of the School of Polymer Science and Polymer Engineering, the college dean, and the dean of Graduate School;
- Submit one electronic version of the thesis via OhioLink and send a fully signed signature page with original signatures to Graduate School approximately one month prior to commencement; and,
- Prepare and submit three hard-bound copies (black cover) each with a signature page bearing original signatures – one each to Polymer Engineering, the student's advisor, and the student.

A manual entitled *Guidelines for Preparing a Thesis or Dissertation* is available in the Graduate School or online at <http://www.uakron.edu/gradsch/current-students/gdlnthessdiss.dot>. All copies of the thesis must conform to the instructions contained therein. The manual will also provide you with details on the specific forms and documentation that need to be completed and submitted with the thesis to Graduate School.

II. ACCELERATED MASTER'S PROGRAM IN POLYMER ENGINEERING (AMP)

FALL 1st Year (12 credits)

Course #	Title	Credits
9841:498	<i>Research Problems in Polymer Engineering</i>	3
9841:621	Rheology of Polymeric Fluids	3
9841:641	Polymer Chemistry & Thermodynamics	3
9841:650	Introduction to Polymer Engineering	3
	TOTAL	12 (9 graduate + 3 undergraduate)

SPRING 1st Year (12 credits)

Course #	Title	Credits
9841:498	<i>Research Problems in Polymer Engineering</i>	9
9841:611	Fundamentals of Polymer Structure Characterization	3
	TOTAL	12 (3 graduate + 9 undergraduate)

SUMMER 1st Year (2 credits)

Course #	Title	Credits
9841:699	Master's Thesis Credit	2

FALL 2ND YEAR (9 credits)

Course #	Title	Credits
9841:6XX/7XX	Elective	6
9841:699	Master's Thesis Credit	3
	TOTAL	9

SPRING 2nd Year (7 credits)

Course #	Title	Credits
9841:601	Seminar in Polymer Engineering	1
9841:631	Engineering Properties of Solid Polymers	2
9841:6XX/7XX	Elective	3
9841:699	Master's Thesis Credit	1
	TOTAL	7

III. DOCTOR OF PHILOSOPHY IN POLYMER ENGINEERING

A. GENERAL INFORMATION

1. Overview

Polymer Engineering administers a graduate program in which students are guided through a course of study and research under the supervision of a faculty member leading to the award of Doctor of Philosophy in Polymer Engineering. Basic requirements of the Graduate School for the doctoral degree are set forth and described in the current *Graduate Bulletin* (graduate catalog) available from Graduate School or online at <http://www.uakron.edu/gradsch/>. Requirements of the Polymer Engineering program are also listed in the *Graduate Bulletin* and are more specifically articulated in this Guidebook. **The combined requirements of the Graduate School and Polymer Engineering program represent the minimum standards for attainment of the degree.** In an effort to tailor the program to each student's background and research interests, Polymer Engineering and/or the student's advisor may request requirements beyond the minimum in order to ensure academic and professional success.

2. Residency Requirements

A doctoral student may meet the degree requirements of the Graduate School and Polymer Engineering by full-time study or a combination of full- and part-time study.

The minimum residency requirement for a doctoral candidate in all programs is at least two consecutive semesters of full-time study and involvement in Polymer Engineering activities.

3. Continuous Enrollment Requirement

The Graduate School requires that a doctoral student register for a minimum of one graduate credit during each fall and spring semester of study; however, **the Polymer Engineering program also requires a minimum of one graduate credit in the summer session.**

4. Time Limit

All doctoral requirements must be completed within ten (10) years of starting coursework at The University of Akron or elsewhere. This refers to graduate work after receipt of a master's degree or the completion of 30 semester credits. An extension of up to one year may be granted in unusual circumstances by the dean of the Graduate School upon written request by the student and recommendation by his/her advisor, director of the School of Polymer Science and Polymer Engineering, and college dean.

5. Credits

A minimum of fifty percent (50%) of the total graduate credits required must be completed through The University of Akron.

No graduate credit may be received for courses taken by examination or for 500-numbered courses previously taken at the 400-number course level as an undergraduate without advance approval from the dean of the Graduate School.

Any graduate course may be repeated once for credit. The credit hours and grades of both the original and the repeated course will be used in computing the grade-point average. Required courses in which either a "D" or "F" were received must be repeated. Repeat for change of grade is not available at the graduate level.

It should be noted that it is entirely within the prerogative of Polymer Engineering to assign additional credits of coursework or other requirements in the interest of graduating a fully qualified student.

6. Transfer Work

As of Fall 2019, Polymer Engineering will only allow a maximum of nine (9) credits to be transferred in from an accredited college or university. All transfer credit must be at the "A" or "B" level (4.00 to 3.00) in graduate courses. The credits must be relevant to the student's program as determined by the student's advisor and director of the School of Polymer Science and Polymer Engineering and fall within the ten-year time limit.

Transfer credit shall not be recorded until a student has completed his or her first year in polymer engineering at The University of Akron with a grade-point average of 3.00 or better. Transfer credit from other institutions shall not be computed as part of a student's University of Akron grade point average.

7. Advising

Until a student has chosen and been assigned to an advisor, all advising questions and issues will be handled by the director of the School of Polymer Science and Polymer Engineering.

During the Fall term, new students will have an opportunity to hear polymer engineering faculty give a formal presentation on their research. In addition, students are to individually discuss research possibilities with each of the polymer engineering faculty. Students will then be asked to provide Polymer Engineering with several choices, in priority order, of faculty members with whom they would like to work. The faculty then meet as a whole to review the choices after which the student will then be assigned to one faculty member who will serve the student as his/her advisor. Thereafter, the faculty member will direct the student in the completion of the academic and research requirements necessary for successful awarding of the doctoral degree. Since the student-advisor relationship in a graduate research investigation is a particularly close one, a student should give careful thought to the choice of an advisor.

8. Registration

Registration for classes should only occur after consulting your advisor. The following enrollment rules are currently in effect for doctoral students:

- a. Full-time doctoral students will register for 12 credits in the first semester of study. After that, doctoral students will register for 9 credits in each Fall and Spring semester and 6 credits in the Summer session.
- b. Part-time doctoral students must register for a minimum of one credit in each Fall and Spring semester and one credit in the Summer session.

- c. **Students who are close to graduating must have defended their dissertation AND been totally cleared by Graduate School to graduate BEFORE the Graduate School deadline in order to be exempt from having to register for a minimum 1 credit in the next term.**

For example, a student takes one (1) credit in the Summer session to finish up but does not defend and upload her finalized dissertation to OhioLink in time to meet the deadline set by Graduate School to graduate in August. Therefore, she must register for one (1) credit in Fall and will not graduate until December.

9. DPR - Degree Progress Report

Graduate Students are able to track their degree progress and review their academic record by logging onto My Akron and accessing their Degree Progress Report (DPR). Students should review their DPR at least once each semester. The DPR report will show all completed and remaining degree requirements. The system may be accessed at any time and will be helpful for planning degree completion. The Graduate School will use the DPR system to review student records prior to graduation; however, it is the responsibility of each graduate student to confirm that she/he has met all degree requirements. As always, you should work closely with your graduate advisor to ensure that you are making adequate progress toward your degree.

10. Leaving the University before Degree Completion

- a. Students who are leaving the polymer engineering program must formally notify both their advisor and the director of the School of Polymer Science and Polymer Engineering.
- b. Students must clean out their workstation and any lab space, turn in all keys, pay any outstanding invoices, fines, or fees, and return any and all borrowed library materials.
- c. If a student is employed with the stipulation of obtaining a doctoral degree and the employer inquires about the completion of the degree, the employer will be told that the degree is unfinished.

11. Graduation - General

Graduate students must apply for graduation online through My Akron. This online application should be submitted by the following dates:

- April 1 for Spring Commencement
- July 1 for Summer Commencement (no ceremony)
- November 1 for Fall Commencement

Further information regarding graduation and/or responding to attend a commencement ceremony may be found here: <http://www.uakron.edu/registrar/graduation/>.

To be cleared for graduation, a candidate must have completed coursework with a minimum cumulative graduate grade-point average of at least 3.00; submitted an online application for graduation with the University Registrar; paid all applicable fees; and met any other applicable Polymer Engineering and University requirements.

Final online submission of a properly prepared dissertation is due to the Graduate School at least three weeks prior to commencement. This copy must be signed by the adviser, the director of the School of Polymer Science and Polymer Engineering, and the college dean prior to submission to the Graduate School. A manual titled *Guidelines for Preparing a Thesis or Dissertation* is available online and all copies of the thesis must conform to these instructions.

12. Graduation – Polymer Engineering

To be cleared for graduation, a student must have:

- Completed all required coursework and research hours with a minimum cumulative graduate grade-point average of 3.00;
- Filed an Application to Graduate;
- Submitted an approved dissertation and passed an oral defense;
- Provided the appropriate number of dissertation copies;
- Paid all applicable fees and/or fines;
- Returned all building and office keys to the Lock Shop;
- Returned all library materials;
- Cleaned up all lab space, equipment, glassware, and student workstation;
- Properly labeled and stored or discarded any chemicals or other equipment;
- Completed an Exit Survey form; and,
- Met any other Polymer Engineering and University requirements.

Failure to follow the above procedures may delay your clearance for graduation and transcripts of academic work and degrees may not be sent by the University to employers or other schools.

13. Copies of Final Dissertation

A student must provide four copies of his/her dissertation as indicated. All four copies require original signature pages:

- One electronic version of the dissertation is to be submitted to OhioLINK plus a fully signed signature page sent to Graduate School;
- One hard-bound copy for Polymer Engineering;
- One hard-bound copy for the student's advisor; and,
- One hard-bound copy for the student.

A doctoral dissertation is to be bound in burgundy hard cover. For further information on dissertation submission and binding, please consult the website for the Graduate School at:

<http://www.uakron.edu/gradsch/current-students/gdlnthesdiss.dot>

B. DEGREE REQUIREMENTS

The Doctorate in Polymer Engineering is awarded to a student after the completion of a prescribed program of course studies, preliminary examinations, and a research project that leads to the preparation of a written dissertation describing the research in a scholarly manner. A student and his/her advisor can plan any additional courses necessary to solve the dissertation research project and/or that allow for the academic and professional growth of the student. A master's degree is not a prerequisite for the doctorate; however, the first year of study will be substantially the same for both the master's and doctoral student.

Currently, to achieve the Ph.D. in Polymer Engineering, a student must complete:

- 96 credits in polymer engineering, including:
 - 12 credits of polymer engineering core courses
 - 10 credits of polymer engineering 600-level electives
 - 9 credits of polymer engineering 700-level electives
 - 3 credits of math
 - 2 credits of technical electives
 - 60 credits of preliminary research and doctoral dissertation (12 credits or more must be of doctoral dissertation)
- An oral presentation of research proposal
- A written dissertation
- An oral defense of the dissertation

1. 96 Credits

The minimum 96 credits for the doctorate degree in polymer engineering are as follows:

- **12 credits of core courses:**

9841:611	Fundamentals of Polymer Structure Characterization	3 credits
9841:621	Rheology of Polymeric Fluids	3 credits
9841:641	Polymeric Chemistry and Thermodynamics	3 credits
9841:650	Introduction to Polymer Engineering	<u>3 credits</u>
	Total	12 credits

- **10 credits of polymer engineering 600-level electives:**

To achieve the 10 credits of electives, please choose from the following:

One credit elective

9841:601 Polymer Engineering Seminar

◆ **Note - All Ph.D. students must register for 9841:601 two times.**

Two credit electives

9841:631 Engineering Properties of Solid Polymers

3 Credit Electives

9841:600 Interfacial Phenomena in Soft Matter

9841:610 Polymer Engineering Analysis

9841:622 Analysis and Design of Polymer Processing Operations I

9841:623 Analysis and Design of Polymer Processing Operations II

9841:651 Polymer Engineering Laboratory

◆ **Note - All full-time and part-time Ph.D. students must take 9841:651 one time. This course requires 9841:622 as a prerequisite.**

9841:661 Polymerization Reactor Engineering

9841:666 Research Methods

9841:675 Carbon-Polymer Nanotechnology

9841:680 Polymer Coatings

Total **10 credits**

- **9 credits of polymer engineering 700-level electives:**

◆ **Note - Electives may be taken from other areas such as polymer science, chemical engineering, mechanical engineering, physics, mathematics, computer science, or other engineering disciplines only with the advisor's approval.**

Two credit electives

9841:712 Rheo-Optics of Polymers

9841:720 Molecular Aspects of Polymer Rheology

9841:721 Rheology and Processing Two-Phase Polymer Systems

9841:722 Advanced Modelling of Polymer Processing

9841:723 Rheology and Processing of Elastomers

9841:724 Advanced Extrusion and Compounding

9841:725 Chemorheology and Processing of Thermosets

9841:727 Advanced Polymer Rheology

9841:731 Stress Analysis of Polymers and Composites

9841:745 Liquid Crystals

9841:761 Injection and Compression Molding Fundamentals

9841:773 Advanced Polymer Coating Technology

9841:778 Advanced Functional Polymers

9841:797 Advanced Topics (announced) in Polymer Engineering

Three credit electives

9841:715	Advanced Characterization of Functional Polymers
9841:728	Numerical Methods in Polymer Engineering
9841:747	Polymer Colloids
9841:749	Phase Transitions in Polymer Blends and Alloys
9841:770	Polymer Nanocomposites
9841:777	Modeling of Nanoscale Materials
9841:797	Advanced Topics (announced) in Polymer Engineering

Total 9 credits

• **3 credits of math:**

- ◆ Course selection to be approved by your advisor.

3450:532	Introduction to Partial Differential Equations
3450:535	Systems of Ordinary Differential Equations
3450:538	Advanced Engineering Mathematics I
3450:539	Advanced Engineering Mathematics II
3450:627	Advanced Numerical Analysis I
3450:628	Advanced Numerical Analysis II
9841:610	Polymer Engineering Analysis

Total 3 credits

• **2 credits of technical electives –engineering, polymer engineering, or polymer science:**

- ◆ Course selection(s) to be approved by your advisor.

4300:681	Advanced Engineering Materials
4600:622	Continuum Mechanics
9841:XXX	Polymer Engineering course
9871:613	Polymer Science Laboratory
9871:674	Polymer Characterization
_____	Other technical elective

Total 2 credits

• **60 or more credits of research:**

9841:898	Preliminary Research
9841:899	Doctoral Dissertation*

**(Minimum of 12 credits required of the 60 total)*

- ◆ Note – Doctoral students will register for Preliminary Research hours until they successfully pass the Defense of Research Proposal. After that, students may register for Doctoral Dissertation hours.

Total 60 credits

TOTAL 96 credits

2. Classes in the First Fall Semester

Classes in the first Fall semester of study for all Ph.D. students are the same:

9841:610	Polymer Engineering Analysis	3 credits
9841:621	Rheology of Polymeric Fluids	3 credits
9841:641	Polymer Chemistry and Thermodynamics	3 credits
9841:650	Introduction to Polymer Engineering	<u>3 credits</u>
	Total	12 credits

3. Dissertation Committee

The dissertation committee is comprised of a minimum five (5) faculty members:

- Student's advisor
- Two faculty from Polymer Engineering
- Two faculty from other disciplines* appropriate to review the research, such as polymer science, physics, chemical or mechanical engineering, chemistry, etc.

**At least one of these two outside faculty members must be from outside the School of Polymer Science and Polymer Engineering, such as other Engineering disciplines or the College of Arts and Sciences. Committee members must hold the appropriate graduate faculty status that allows them to serve on doctoral dissertation committees.*

The advisor and student will jointly choose the committee members based upon each member's research interests, expertise, and availability. Once the committee is chosen, the student needs to complete and submit a Doctoral Dissertation Committee Membership form <http://www.uakron.edu/dotAsset/677917.pdf> detailing the membership. This form should be given to the Polymer Engineering office for your file and for Graduate School ratification and approval as soon as possible, but no later than three months before the student's actual dissertation defense. If there are any changes to the committee membership thereafter, the student shall send a revised committee membership list to the Polymer Engineering office to assure Graduate School ratification and approval.

4. Oral Research Proposal

Because the research investigation is so important, students should begin research with their advisor as early as possible, and certainly before the end of the first semester of graduate study. If the student then fails to display an aptitude for engineering/scientific research, as judged by the student's advisor, he/she may then be advised not to proceed towards the doctoral degree without losing too much time. In some cases, the student (or the advisor) may request a change of research problem or advisor in order to have a second chance to do research in a field in which the student may be more successful.

a. Purpose

The purpose of the oral proposal is to enable a dissertation committee to understand a student's chosen field of interest and to evaluate his/her range of knowledge in polymer engineering. The critical review undertaken by the committee will serve to assist the student in organizing his/her methodology and ideas in order to successfully complete the dissertation.

Only preliminary research results to establish feasibility are required. The written version of the proposal must be limited to a maximum of 15 pages and needs to be submitted to the individual committee members at least two weeks prior to the oral presentation so that each member has sufficient time to review it. Students will arrange a room through the Polymer Engineering office for the proposal.

b. Deadline

Students have eighteen (18) months from the first day they enter the program to give an oral presentation of their proposed research to their dissertation committee.

The defense must be completed by **March 1 of the student's second year** which is approximately 18 months from the date of entering into the Ph.D. program. Specific deadlines are as follows (exceptions need the approval of the advisor **and** the director of the School of Polymer Science and Polymer Engineering). Note that these deadlines represent the last day for completing the task:

Candidate submits written draft of proposal to advisor	End of third semester
Advisor returns comments on draft to student	Beginning of fourth semester
Candidate submits written proposal to Polymer Engineering and Committee	Two weeks prior to defense
Defends written proposal	March 1

If the candidate does not pass first oral defense

The candidate will have six (6) weeks from the date of the first oral defense to revise the written proposal and defend it at a second oral defense.

If the candidate does not pass second oral defense

Ph.D. candidacy is withdrawn, and the student has the option to either leave The University of Akron or to complete and defend an M.S. thesis.

Failure of candidate to submit written proposal or defend first oral exam by deadlines

Candidate automatically fails first oral defense but may have a second oral defense within six (6) weeks of the date of the first oral defense deadline.

Failure of candidate to submit written proposal or defend second oral exam by deadlines

Ph.D. candidacy is withdrawn, and the student has the option to either leave The University of Akron or to complete and defend an M.S. thesis.

c. Format of Research Proposal

The research proposal will utilize NSF guidelines for formatting.

Length (including figures, but excluding references): 15 pages – single spaced with empty lines between paragraphs (or double spaced with first line of paragraph indented)

Font: Arial (11 point); Helvetica (11 point); Palatino (11 point); Times Roman (12 point); Calibri (12 point); Cambria (12 point)

Figures: Figures must be large enough to be readable. Any type in a figure (as printed) must be at least 7 point for Arial, Helvetica or Palatino or 8 point for Times New Roman, Calibri or Cambria.

The research proposal should include the following headings:

- Objective (simple statement of goals of research – what will be accomplished/learned)
- Justification (brief description of why this objective is relevant/important/useful)
- Introduction (including discussion of pertinent literature)
- Proposed Research (including materials, instrumentation and procedures that will be used; may include discussion of preliminary work if relevant)
- References (not part of 15-page limit) –should be in the following format:

Author 1; Author 2; Author 3; etc. Title of Article. *Journal Abbreviation* **Year**, *Volume*, Inclusive Page numbers.

You may use superscripts of numbers in parentheses, e.g., (4) or (4-6), for references in the body of the proposal.

To cite more than one reference by the same principal author and various co-authors, use the principal author's name followed by "and co-workers" or "and colleagues". For example:

Pauling and co-workers 10,11
Cramer and colleagues (27–29)

When citing more than one reference at one place, list the numbers in ascending order and separate them by commas (*without* spaces as superscripts, *with* spaces on line), or if they are part of a consecutive series, use an en dash (-) to indicate a range of three or more, e.g.,

in the literature^{2,5,8} or in the literature (2, 5, 8)
were reported^{3–5,10} or were reported (3–5, 10)

d. After the Proposal

Sometime after the oral proposal, the dissertation committee will convene to discuss the proposed research and counsel the student on the need for new experiments, further data analysis, and/or the type and extent of discussion that should be present in the written dissertation. Although the student's advisor can ask for more experimental and theoretical work at any time, this is the last time any of the other committee members may request new laboratory work. Both the student and his/her advisor are responsible for seeing that the agreed-upon committee requests and recommendations are carried out before the later submission of the written dissertation.

In the event that a member of the committee is not able to be present at the oral proposal, the student and his/her advisor should try to meet separately with the committee member to review the substance of the research presentation. If a meeting is not possible, the advisor must get comment from the committee member about the proposed work, so the student has feedback from all committee members before proceeding in his/her research

5. Dissertation and Oral Defense

a. Purpose

While investigation of a research problem is an essential part of the master's degree program, it is even more critical in the doctoral degree program because Ph.D. dissertations (the written account of the research) in engineering and science disciplines are universally regarded as evidence of research ability. The doctoral student must conduct a research investigation that is substantial, which contributes significantly to scientific knowledge, and is suitable for publication in the general scientific literature. This latter test implies that the research is judged by impartial scientific referees to be worthy of publication because such a referee system is a feature of all scholarly scientific literature. However, not all Ph.D. dissertation research is judged to be suitable for publication immediately because other questions may be raised by the work which merit further investigation. The suitability for publication remains the one generally accepted criterion of a satisfactory level of accomplishment in research for the Ph.D. degree.

b. Written Dissertation

The written account of a doctoral student's research is known as a dissertation. The dissertation must exhibit an advanced level of understanding of the principles of polymer engineering and science, scientific merit, originality, evidence of critical power, and knowledge of previous work. A manual entitled *Guidelines for Preparing a Thesis or Dissertation* is available in the Graduate School or online at <http://www.uakron.edu/gradsch/current-students/gdlnthediss.dot>. Students should obtain a copy of this at the outset of their writing, as all copies of the dissertation must conform to the instructions detailed therein. The manual will also provide students with details regarding the specific forms and documentation that must be completed and submitted along with the dissertation to Graduate School.

c. Oral Defense of Dissertation

The oral defense is a final presentation of a student's dissertation research to his/her committee that is also open to the public. The student and committee will establish a mutually agreeable date and time for the oral defense. Students must see the Polymer Engineering office to arrange for a room for the defense and to provide the details and abstract of his/her presentation for public announcement.

- The dissertation must be submitted to Polymer Engineering for plagiarism check and approved by the advisor.
- The defense must be publicly posted, and final copies of the dissertation submitted to each faculty member on the committee **at least two weeks prior to the actual defense date.**
- Prior to the oral defense, the student should obtain the "Doctoral Dissertation Defense Report" form from the Polymer Engineering webpage <http://www.uakron.edu/dpe/about-us/forms.dot>

The oral defense is the last opportunity for a student to obtain a critical review of his/her work before submitting the completed dissertation to the Graduate School. The format for the oral defense is as follows:

- i. The student will give approximately a 30-minute presentation of the summarized results and conclusions of his/her research using visual aids.
- ii. After the presentation, the floor will be turned over to committee members for questions.
- iii. Immediately after the defense, the dissertation committee members will meet in private to discuss the dissertation. After discussion, the committee chair will take a formal vote of the committee concerning acceptability of the dissertation and its defense. A vote of acceptability by 4/5 of the committee constitutes a passing defense.
- iv. The committee chair and/or advisor will then provide the student with the committee's feedback and the need for any further corrections.
- v. A pass/fail "Doctoral Dissertation Defense Report" will be submitted by the chair to the Polymer Engineering office which will, in turn, forward the report to the Graduate School and place a copy in the student's academic file.

If a member of the committee does not arrive for the defense, every effort should be made to locate the missing faculty member. In the case of a personal emergency forcing a committee member to be absent, the student and/or his/her advisor may ask another faculty member to sit in on the defense, but only after Graduate School has been notified and given approval. If the absent committee member is also the chair of the committee, then one of the other members may assume the role of chair for the defense. If two or more members are absent, the defense may not proceed and will need to be rescheduled.

If the candidate does not pass first dissertation defense

The committee may allow the student to make a second defense attempt, rewrite the dissertation, or both. The committee will define the timeline for completion.

If the candidate does not pass second dissertation defense

If a student fails a dissertation defense on the second try, he/she will be asked to leave the program.

d. Finalizing the Dissertation and Submission of Dissertation to Graduate School

After a successful oral defense, the student will:

- Make any required corrections to the dissertation as mandated by the committee;
- Obtain the appropriate signatures which include: advisor, co-advisor (if any), committee members, director of the School of Polymer Science and Polymer Engineering, college dean, and the dean of Graduate School;

- Submit one electronic version of the dissertation via OhioLink and send a fully signed signature page with original signatures to Graduate School approximately one month prior to commencement; and,
- Prepare and submit three hard-bound copies (burgandy cover) each with a signature page bearing original signatures – one each to Polymer Engineering, the student's advisor, and the student.

A manual entitled *Guidelines for Preparing a Thesis or Dissertation* is available in the Graduate School or online at <http://www.uakron.edu/gradsch/current-students/gdlnthediss.dot>. All copies of the dissertation must conform to the instructions contained therein. The manual will also provide you with details on the specific forms and documentation that need to be completed and submitted along with the dissertation to Graduate School.

IV. STUDENT FUNDING

A. GENERAL INFORMATION

Polymer Engineering is currently able to provide financial assistance to a number of qualified, full-time doctoral students each year. Funds for student support are available from several principal sources, including:

- The Graduate School at The University of Akron;
- Externally funded research activities such as research contracts or grants obtained by a professor in polymer engineering; and,
- Private companies, individual donors, and government and public foundations that give specific grants to Polymer Engineering or to individual students for fellowships, scholarships, or other awards.

Student funding decisions are made each fiscal year contingent upon the amount of money Polymer Engineering receives for student aid. Due to fluctuations in economics and budget allocations, **there are no guarantees to any student of financial assistance.**

B. TYPES OF AID

1. Teaching Assistantships Funded by Polymer Engineering – Doctoral Level Only

All first-year doctoral students are required to serve as teaching assistants. The Polymer Engineering program receives its funding for first year doctoral students directly from the Graduate School at The University of Akron. Teaching assistantships require full-time study plus twenty (20) hours of service which may be in Polymer Engineering or in other STEM areas on campus. Master's students are not eligible for funding.

At the conclusion of an assistantship contract, a student may be eligible for continued support based on various factors:

- a. Availability of funding;
- b. Student's year of study in the polymer engineering program;
- c. Total credit hours completed and cumulative GPA; and,
- d. Satisfactory performance of previous teaching assistant responsibilities.

2. Assistantships Funded by Polymer Engineering Faculty Grants or Contracts – Doctoral Level Only

These assistantships may be awarded to full-time doctoral students in their second year or higher directly by a faculty member (also known as the grant or project director or principal investigator). The purpose of the assistantship is to carry out the goals of the project's research focus as defined by the project director. The project director determines the dates of the assistantship and stipend amount consistent with the funds he or she has available and the industriousness of the student. Students are required to maintain good academic standing. Doctoral students should inquire directly of their advisor regarding these opportunities. Master's students are not eligible for funding.

3. Tuition Scholarships/Fellowships (Tuition Remission) – Doctoral Level Only

Tuition scholarships are awarded to full-time doctoral students in conjunction with an assistantship. The tuition scholarship provides for tuition remission while the assistantship provides a biweekly stipend. Master's students are not eligible for funding.

4. Student Employment – Master's and Doctoral Students

Full-time students who do not receive any type of graduate assistance may be eligible to work in a variety of capacities in and around campus as student employees. Students should inquire of these opportunities and eligibility through the website of the Office of Student Employment at:
<http://www.uakron.edu/career/student-employment>.

5. Installment Payment Plan – Master's and Doctoral Students

For students without financial assistance there is also the option of the Installment Payment Plan (IPP) wherein registration expenses may be spread into installments over a semester depending upon when the application for the plan is received. For further information, please visit www.uakron.edu/paymentoptions/ or contact the Installment Payment Plan Office at 330-972-5100.

V. SEMINARS AND LECTURES

A. 9841:601 POLYMER ENGINEERING SEMINAR

The Polymer Engineering Seminar course offers students an opportunity to hear speakers from other universities or private industries present the latest in their research efforts. Lecturers are selected on the basis of outstanding contributions in their field of interest and an effort is made to have the lectures cover different areas of specialization or points of view. In addition to speakers from off campus, seminars may also be given by faculty members in Polymer Engineering or other disciplines on campus.

9841:601 is a required course of all students. Master's students must register for 9841:601 one time. Doctoral students must register for 9841:601 two times.

B. COVESTRO LECTURESHIP IN POLYMER ENGINEERING

Made possible by funding from Covestro, this lectureship was created to invite a distinguished scholar from academia to visit Polymer Engineering and to offer a two-day seminar series on contemporary topics of interest to the polymer community at The University of Akron and the Covestro facility in Pittsburgh, PA. Covestro is one of the world's largest producers of polymers and high-performance plastics. Its innovative developments in coatings, adhesives, insulating materials and sealants, polycarbonates and polyurethanes significantly enhance the quality of life, particularly in the automotive and construction, electrical and electronics, household, sports and leisure sectors.

C. JAMES L. WHITE LECTURESHIP IN POLYMER ENGINEERING

This lecture series is named in honor of the late Dr. James Lindsay White, the professor who founded the Institute of Polymer Engineering and later the Department of Polymer Engineering (now part of the School of Polymer Science and Polymer Engineering). Professor White passed away in 2009 at the age of 71 and is remembered by former students, peers, and colleagues as an incredibly important figure both to The University of Akron and the world of science at large.

Some of Professor White's many contributions included the founding of two scientific journals, *The Journal of Polymer Engineering* and *The International Polymer Processing Journal*, as well as The International Polymer Processing Society, a professional society that holds two conferences a year across the globe. In addition to the Polymer Engineering program here at UA, White is recognized as the founder of a similar program at The University of Tennessee where he first began his teaching career. He authored 500 scientific publications and eight books during his lifetime.

D. SPECIAL SEMINARS

A number of special seminars are scheduled throughout the year, hosted by Polymer Engineering, other campus disciplines, or outside entities. Notices of these lectures are posted on the various bulletin boards throughout the Polymer Engineering buildings.

E. THESIS AND DISSERTATION DEFENSES

Presentations given by graduate students in defense of master's theses or doctoral dissertations are open to anyone to attend. Students are encouraged to support one another in attending defense seminars. It will also give newer students the opportunity to see and hear what will be expected from them at a later date.

VI. POLYMER ENGINEERING STUDENT ORGANIZATION (PESO)

A. PURPOSE

All graduate students in polymer engineering are eligible for free membership in PESO. The purpose of the group is to provide a professional and social forum for all graduate students interested in the discipline of polymer engineering.

B. ACTIVITIES

Some of the many activities of PESO include:

- Attendance at national scientific conferences;
- Coordinating various career workshops and seminars that address professional development;
- Participation in University governance to represent current graduate student views on educational issues;
- Hosting seasonal or holiday parties or picnics; and,
- Organizing athletic teams for intramural sports as well as individual sporting events.

C. OFFICERS

All full-time polymer engineering graduate students are eligible to vote each year for PESO officers, including a president, vice-president, treasurer, secretary and coordinators. Length of appointment is for one year.

D. FUNDING

PESO is recognized as a student chapter of the Society of Plastics Engineers (SPE). The operating budget for PESO is derived from both the SPE and The University of Akron and is based on budget proposals submitted each Spring by the group's officers.

VII. POLICIES

A. GRADES AND ACADEMIC STANDING

1. Grade Point Average (GPA)

Good academic standing is a requirement for continuing study in Polymer Engineering and for receiving financial support. Academic standing is monitored both by Graduate School and a committee of polymer engineering faculty at the conclusion of each grading period.

Any student whose cumulative graduate grade-point average falls below 3.00 is no longer in good academic standing and will:

- risk loss of funding;
- receive a letter of warning from Graduate School; and,
- be placed on academic probation by Graduate School.

The dean of the Graduate School, in consultation with the director of the School of Polymer Science and Polymer Engineering, will dismiss full-time students who do not return to good academic standing within two consecutive semesters (excluding Summer sessions) and part-time students who do not return to good academic standing within the attempting of 15 additional credits.

2. Grades of "C+" or Lower

The dean of the Graduate School, with the approval of the director of the School of Polymer Science and Polymer Engineering, may also dismiss anyone who fails to make satisfactory progress toward declared goals or who accumulates six semester credits of "C+" or lower. The accumulation of six semester credits of "F" will result in mandatory dismissal. (Note: Grades of "D+", "D", and "D-" are treated as "F" grades.) A student dismissed by the Graduate School for academic reasons may not be readmitted for one calendar year, and then only if evidence for expecting satisfactory performance is submitted and found to be acceptable.

B. ACADEMIC DISHONESTY – POLYMER ENGINEERING LEVEL

Polymer Engineering considers academic integrity an essential part of each student's personal and intellectual growth. Instances of academic dishonesty are addressed consistently. It is each student's responsibility to know what constitutes academic dishonesty and to seek clarification directly from the instructor if necessary. Examples of academic dishonesty include, but are not limited to:

- Submission of an assignment as the student's original work that is entirely or partly the work of another person (e.g. copying of homework assignments);
- Failure to appropriately cite references from published or unpublished works or print/non-print materials;
- Failure to use quotation marks and appropriate citations when using exact wording from another source;
- Unauthorized copying of an assignment in computer programming, or the unauthorized examination or view of the computer, specifically during examinations;
- Possession and/or unauthorized use of tests, notes, books, calculators or formulas stored in calculators not authorized by the instructor during an examination;
- Providing and/or receiving information from another student other than the instructor, by any verbal or written means;
- Observing or assisting another student's work;
- Violation of the procedures prescribed by the professor to protect the integrity of the examination; and,
- Cooperation with a person involved in academic misconduct.

Polymer Engineering is explicit in its own policies toward academic dishonesty as follows:

1. For Students Formally Admitted to Polymer Engineering

- a. Cheating on any examination can lead to dismissal from the master's or doctorate program.

- b. Misrepresentation of any laboratory results or other data that appear in either course reports, presentations or seminars, theses or dissertations, or any other polymer engineering or polymer science publication can lead to dismissal from the master's or doctorate program.
2. For Students Not Yet Formally Admitted or Only Provisionally Admitted to Polymer Engineering
- a. Cheating on any examination can lead to denial of admission to the master's or doctorate program.
 - b. Misrepresentation of any laboratory results or other data that appear in either course reports, presentations or seminars, theses or dissertations, or any other polymer engineering or polymer science publication can lead to denial of admission to the master's or doctorate program.
3. For Students from Majors Other Than Polymer Engineering
- a. The instructor of the course in which the dishonesty occurred will determine the appropriate penalty for any classroom examination cheating or any dishonest report writing.
 - b. Penalties may range from getting a "0" on a specific exam or report to receiving a grade of "F" for the entire course.
4. For All Students
- a. A student who has been accused of academic dishonesty will be asked to meet with the course instructor. Instructors in polymer engineering are required to place a description of the offense in writing into a student's academic file. Before determining the final penalty for any act of dishonesty, an instructor must review the student's file to ascertain if the student has been dishonest previously and, if so, a more serious penalty may be deserved, prescribed, and upheld later in the event of a formal hearing.
 - b. Students who disagree with an accusation of academic dishonesty may appeal first to the director of the School of Polymer Science and Polymer Engineering in writing. If still not resolved, the student may then appeal to the dean of the College of Engineering. A record of all appeals correspondence and decisions will be maintained in the student's file.

C. ACADEMIC DISHONESTY – GRADUATE SCHOOL LEVEL

Students at The University of Akron are an essential part of the academic community and enjoy substantial freedom within the framework of the educational objectives of the institution. The freedom necessary for learning in a community so rich in diversity and achieving success toward educational objectives requires high standards of academic integrity. Academic dishonesty has no place in an institution of advanced learning. The University community is governed by the policies and regulations contained within the *Code of Student Conduct* available in the University's Office of Student Conduct and Community Standards.

The University of Akron considers academic integrity an essential part of each student's personal and intellectual growth. Instances of academic dishonesty are addressed consistently. All members of the community contribute actively to building a strong reputation of academic excellence and integrity at The University of Akron. It is each student's responsibility to know what constitutes academic dishonesty and to seek clarification directly from the instructor if necessary. Examples of academic dishonesty include, but are not limited to:

- Submission of an assignment as the student's original work that is entirely or partly the work of another person (e.g. copying of homework assignments);
- Failure to appropriately cite references from published or unpublished works or print/non-print materials;
- Failure to use quotation marks and appropriate citations when using exact wording from another source;
- Unauthorized copying of an assignment in computer programming, or the unauthorized examination or view of the computer, specifically during examinations;
- Possession and/or unauthorized use of tests, notes, books, calculators or formulas stored in calculators not authorized by the instructor during an examination;
- Providing and/or receiving information from another student other than the instructor, by any verbal or written means;

- Observing or assisting another student's work;
- Violation of the procedures prescribed by the professor to protect the integrity of the examination; and,
- Cooperation with a person involved in academic misconduct.

A student who has been accused of academic dishonesty will be asked to meet with the course instructor. The matter can be resolved informally at the school level and/or an academic sanction can be imposed. If the student opposes the decision, he/she may appeal to the college dean. A further discussion of these procedures and other avenues for recourse can be found in University Rule 3359-24-02 *Grievance Procedures for Graduate Students*, available through the Office of General Counsel, www.uakron.edu/ogc.

D. COMPUTER AND SOFTWARE USAGE

The University of Akron provides numerous computer labs on campus, including a computer lab for use of only polymer engineering students in PEAC 205. This lab provides general computing capabilities plus several specialized software programs that are of beneficial use to students in their polymer engineering courses. In addition, most faculty provide a common computer and/or laptop for use by students in his/her group and there are some computers in conjunction with equipment in the Olson Research Center and National Polymer Innovation Center laboratories. In all cases, the computers are to be used to further your academic study and professional activities.

According to The University of Akron Code of Student Conduct,

“Unauthorized copying of an assignment in computer programming, unauthorized examination or view of the computer accounts for unauthorized purposes, unauthorized use of an individual’s identification or University password or University computer in violation of rules 3359-11-09 and 3359-11-10 of the [State of Ohio Revised] Administrative Code, engaging in disruptive, or mischievous behavior on the computer, or any other wrongful use of a computer...”

constitutes a violation of the Code of Student Conduct and will result in disciplinary action. Student conduct hearings are held in addition to and separate from any criminal or civil court proceedings. Some common examples of misuse are downloading software without proper authority or license and downloading copyrighted movies and music. Such activities are violations of federal and state laws and both University and Polymer Engineering policy. The University of Akron Code of Student Conduct may be found online at <http://www.uakron.edu/studentconduct/code-of-conduct.dot> or you may contact the Office of Student Conduct and Community Standards by phone at 330-972-6380 or in person in Simmons Hall, Room 302.

E. INTELLECTUAL PROPERTY RIGHTS AND OBLIGATIONS

During your graduate study at The University of Akron and your professional career thereafter, you may become involved with at least one of the three main forms of intellectual property -- copyright, patents, and proprietary information/trade secrets.

1. Copyright

By law, an author automatically owns copyright to his/her work when it is placed in a fixed form (or medium). The University Board of Trustees automatically waives any claim of the University to copyright in books, texts, or articles authored by faculty or students except when the material is prepared as a sponsored project. In that case, the work is the property of the University and ownership is assigned to the University or its designee as the Board of Trustees directs.

2. Patents

All polymer engineering graduate students are required to sign an “Invention Patent Agreement” form before being permitted to participate in any formal research project or activity at The University of Akron. This form is available from the Polymer Engineering office or through your advisor.

In addition, all discoveries and inventions made by you in the course of your research work at The University of Akron must be reported to your faculty advisor, and through your advisor to the director of the School of

Polymer Science and Polymer Engineering, the college dean, and the Office of Research Services and Sponsored Programs using the standard University of Akron Invention Disclosure Form available online at <https://www.uakron.edu/research/faculty/> This form provides a guide to describing and identifying the invention and referencing specific results.

Patents on inventions made by University faculty, staff, students, or anyone using University facilities are automatically owned by The University of Akron, as provided by Ohio Revised Code, Section 3345.14. The final decision as to ownership is a technical legal conclusion and will be made in the course of preparing a patent application by the patent attorney handling the application.

In the event you think you have been omitted as an inventor on a patent application, you should first discuss the matter with your advisor and, thereafter, with the director of the School of Polymer Science and Polymer Engineering and finally with the college dean. Following such consultations, either you and your advisor, or the director of the School of Polymer Science and Polymer Engineering, or the college dean can request the patent attorney who prepared the application to recheck the findings and then prepare a formal report on inventorship. The whole patent application file may then be referred to the University's Office of General Counsel for a re-evaluation of valid inventors. However, such a re-evaluation by patent counsel shall only occur with the prior knowledge of your advisor, the director of the School of Polymer Science and Polymer Engineering chair, and college dean.

3. Proprietary Information/Trade Secrets

Faculty and students engaged in sponsored research may also be involved with developing or receiving proprietary information owned by others outside the University (e.g., sponsors such as corporations or individuals seeking certain research from the University). The sponsor desires, in these situations, to keep the information confidential (or secret) for as long as possible. As a result, you are free to use the proprietary information in the course of the project and discuss it with other students or faculty members engaged in that project. However, you may not use the information on other projects or discuss it with other individuals who are not involved with the project. While these commitments may delay public access to your thesis/dissertation for a specified time, it will not delay acceptance or approval of your thesis/dissertation nor delay your graduation date.

Due to the issue of confidentiality, the University and principal investigator must obtain written, personal commitments from anyone working on a project that utilizes proprietary information. Therefore, all research students are required to execute a Confidentiality Agreement. If your work on any research project is subject to confidentiality provisions, it is the responsibility of the principal investigator to inform you of such in writing and of any restrictions on the research. If you have any questions as to what information is proprietary, seek guidance from the project's principal investigator or your faculty advisor.

VIII. MISCELLANEOUS

A. STUDENT OFFICES

After being assigned to a faculty advisor, all full-time graduate students in Polymer Engineering will be assigned an individual workstation in the Polymer Engineering Academic Center (PEAC).

The student offices and workstations in the PEAC building are provided to students for academic work only. No research or experiments may be conducted, or chemicals used or brought into the PEAC building at any time. Failure to follow this very important rule may result in disciplinary action of the student by the director of the School of Polymer Science and Polymer Engineering and/or faculty advisor.

Student office space is a privilege, not an entitlement. Students are expected to keep their desks free from clutter, clean and dusted at all times. Student offices should be vacuumed weekly and in orderly fashion. Each student has a responsibility to maintain good and safe housekeeping practices. Failure to do so may result in loss of the privilege.

B. KEYS AND CARD READER ACCESS

Students will be assigned keys to their student office and desk located in PEAC. Students will also receive keys to various areas in the Olson Research Center and/or National Polymer Innovation Center as deemed appropriate to their research by their advisor. The form to apply for a key(s) may be found on the student forms section of the DPE website: <http://www.uakron.edu/dpe/about-us/forms.dot>. You will receive a notification via email when your keys are ready to be picked up from the Lock Shop (generally within two weeks time of making application). Failure to pick up keys by the deadline on the notification will result in a fine imposed on the student. Upon leaving the polymer engineering program for any reason or upon graduation, all keys must be returned directly to the University's Lock Shop.

Card reader access provides the ability for students to enter the Polymer Engineering Academic Center, Olson Research Center, and National Polymer Innovation Center after hours and on weekends as well as access over the bridge between PEAC and Olson, to the student computer lab in PEAC 205, and for use of the PEAC copiers. Access may only be granted upon a student's receipt of a University Zip Card and UANet Identification number and is valid only while the student is enrolled.

C. PARKING

All full-time doctoral students who hold a tuition scholarship or fellowship are entitled to a reduced fee of one parking permit, valid in student campus lots for each semester or Summer session of the award. All other students will pay the parking permit fee in effect at the time of their application. For the most up-to-date information on obtaining a parking permit please visit the Parking Services section of your My Akron page.

D. MAIL

Each student is assigned a mailbox in which to receive regular and campus mail. Student mailboxes are located in the Olson Research Center next to the bridge. Mail is delivered to Polymer Engineering once in the morning and once in the afternoon each day. A mailbox for outgoing mail is located off the atrium of the Polymer Engineering Academic Center by the dock exit. There are outgoing slots for both U.S. mail and campus mail.

The mailing address for students in polymer engineering to receive regular postal mail is:

(Your Name)
Polymer Engineering Academic Center
The University of Akron
250 S. Forge St.
Akron, OH 44325-0301

E. TELEPHONES AND FAX

The main phone number for Polymer Engineering is 330-972-6865 and may be used in case of emergency.

- While on campus, all telephone numbers to University offices may simply be dialed by picking up the phone and dialing the last four digits of the phone number. For example, to dial the 4th floor reception area, simply dial “6865.”
- For off campus local telephone numbers, dial “9” to get an outside line, followed by the “330” area code and seven-digit phone number.
- For off campus long-distance telephone numbers, dial “9” to get an outside line, followed by “1” for long distance, then the area code and seven-digit phone number.

Students are permitted to receive faxes in Polymer Engineering. The fax machine is located in PEAC 402. The number at which to receive all faxes is 330-972-3406. Students are also permitted to send faxes related to their academic and research work at their advisor’s discretion. Personal faxes may be made only with permission and reimbursement. All faxes should be dialed according to the instructions listed above.

F. STUDENT ADDRESSES AND EMERGENCY CONTACTS

Each student is required to maintain a current local address, telephone number, and e-mail address. In addition, it is important that the university also know who you wish to be contacted in case of an emergency. Since these records are vital to your welfare while at The University of Akron, it is important that you update this information in your My Akron profile whenever there is a change in your personal data.

G. MEDICAL INSURANCE

Since the discipline of polymer engineering requires extensive use of laboratory facilities, it is required that all students carry some sort of medical insurance coverage while attending The University of Akron. All registered students taking six or more credit hours, master’s and doctoral students, ELI students, and other special academic program students are eligible to enroll in a student health insurance plan offered by the University of Akron: <https://www.uakron.edu/healthservices/insurance/>.

H. HEALTH SERVICES

Health Services is a medical clinic on campus that is available to all students for treatment of minor illness or injury. The office is located in Suite 260 of the Student Recreation and Wellness Center. The telephone number is 330-972-7808. In addition, the University is within just a few minutes of several hospitals offered by Cleveland Clinic, Summa Health System, University Hospitals, and Akron Children’s Hospital.

I. SECURITY

The issue of security is a responsibility that must be shared by all members of Polymer Engineering – students, faculty, contract professionals, and staff alike. Doors must be kept locked when a room is unoccupied. Desks and equipment cabinets should be locked overnight and on weekends. Backpacks, purses, calculators, radios, and all other items of a personal nature should be kept out of sight or locked up when they are not actually being used. Students who are working at hours when there are few other people around should be sure that someone knows where they are and what they are doing. In the case of a building emergency, either in the Polymer Engineering Academic Center, National Polymer Innovation Center, or in the Olson Research Center, it is important that someone be aware of the fact that you are working and where.

While most people you encounter in any of the polymer buildings will have legitimate business in these areas, all students, faculty, contract professionals, and staff have the right to politely question any individual about who they are looking for and then assist them accordingly. Unauthorized individuals who enter restricted areas are to be informed that they are in an area where unescorted visitors are not permitted and then directed to the administrative office. In case of any problems or situations in which you feel uncomfortable, do not hesitate to contact the

University Police immediately. For emergencies simply dial 911 from the nearest campus phone; for non-emergencies, please dial x2911 or 330-972-2911.

If you are working late in either building and would prefer to have someone walk you to your car for safety, the University Police offer a free escort service to students simply by calling Campus Patrol at x2911 or 330-972-2911.

J. CAREER OPPORTUNITIES AND ASSISTANCE

Generally, there are many excellent employment opportunities available for graduates of the polymer engineering program at The University of Akron. Career opportunities and assistance may be available in several different ways:

1. Job postings received by Polymer Engineering are posted on the Jobs Bulletin Board located near the student mailboxes on the Olson side of the bridge, e-mailed to all students and post-docs, and posted on Polymer Engineering's website.
2. On-campus visits and interviewing by company recruiters.
3. The University of Akron Career Services offers job placement assistance as well as conducts numerous career workshops and recruiting fairs, all of which are available to both undergraduate and graduate students. To take advantage of all the many opportunities available through Career Services, please visit <https://www.uakron.edu/career/> or contact them directly at 330-972-7747 or visit them in Room 211 of the Student Union.
4. Networking through membership in professional organizations and societies, through contacts of Polymer Engineering faculty, attendance at conferences, and activity in the Polymer Engineering Student Organization.

IX. FACULTY

Dr. Kevin Cavicchi, Professor of Polymer Engineering

- Phone: 330-972-8368 E-Mail: kac58@uakron.edu
- 2003 - Ph.D. in Materials Science and Engineering, University of Minnesota
- Structure-property relationships of nanostructured soft materials; thermodynamics of small molecule organogelators and polymer/organogelator blends; synthesis and characterization of shape memory polymers; synthesis and characterization of supramolecular polymers through ionic interactions including block copolymers, ionically crosslinked elastomers, and polyelectrolyte-surfactant complexes.

Dr. Xiong Gong, Professor of Polymer Engineering

- Phone: 330-972-4983 E-Mail: xgong@uakron.edu
- 1997 - Ph.D. in Physics, Nankai University
- Flexible electronics, uncooled solution-processed ultrasensitive broad-band photodetectors; polymer photovoltaics, hybrid perovskite photovoltaics; organic-based thermoelectric devices; supercapacitors and self-powered electronics; novel organic/polymeric and organic-inorganic hybrid materials; high electrical conductive inorganic quantum dots and nanostructured materials.

Dr. Sadhan C. Jana, Benjamin Franklin Goodrich Professor of Polymer Engineering

- Phone: 330-972-8293 E-Mail: janas@uakron.edu
- 1993 - Ph.D. in Chemical Engineering, Northwestern University
- Design of functional materials for oil/water separation, drug delivery, and photocatalysis; mesoporous gel, aerogel, and aerogel foam structures in energy storage, nanoparticle filtration, virus removal, and oil-water separation; design of fillers for low rolling resistance rubber; metamaterials by 3D printing; novel scaffolds for tissue culture.

Dr. Fardin Khabaz, Assistant Professor of Polymer Engineering and Assistant Professor of Chemical Engineering

- Phone: 330-972-5410
- 2016 - Ph.D. in Chemical Engineering, Texas Tech University
- Physics of soft matter using theoretical and simulation tools; transport processes; design of advanced materials for processing, separation, and energy applications; multiphase flow; dynamics of molecules in geometrical confinement; jamming in suspensions and molecular glasses; thermodynamics and rheology of polymer blends and dynamic polymer networks.

Dr. Thein Kyu, Distinguished Professor of Polymer Engineering

- Phone: 330-972-6672 E-Mail: tkyu@uakron.edu
- 1980 - Ph.D. in Polymer Chemistry, Kyoto University, Japan
- Phase equilibria and kinetics of phase separation in polymer blends; phase transitions in crystalline and liquid crystalline polymers; flexible and stretchable lithium ion polymer batteries; ion-exchange membranes; pattern formation dynamics and electro-optical properties of dispersed liquid crystal and photonic crystals and flexoelectric polymer electrolyte membranes.

Dr. Ruel McKenzie, Assistant Professor of Polymer Engineering

- Phone: 330-972-5344 E-Mail: rmckenzie@uakron.edu
- 2013 - Ph.D. in Chemical Engineering, New York University
- Dynamics of complex systems; experimental physics of soft condensed matter; kinetics and dynamics of state transitions; enabling complex structures using advanced manufacturing and chemical synthesis techniques; multifunctional, adaptable and stimuli-responsive materials; nanocomposites; structure-processing-property-function characterization and relationships.

Dr. Mark D. Soucek, Sundar L. Aggarwal Professor of Polymer Engineering

- Phone: 330-972-2583 E-Mail: msoucek@uakron.edu
- 1990 - Ph.D. in Inorganic Chemistry, University of Texas
- Coatings technology in high solids, waterborne, UV-curable and powder coatings; environmentally benign coatings; nanophase inorganic/organic coatings; study of crosslinking processes; self-stratifying coatings; corrosion resistant coatings; anti-reflective coatings; magnetic initiators for cure on demand.

Dr. Weinan Xu, Assistant Professor of Polymer Engineering

- Phone: 330-972-6675 E-Mail: weinanxu@uakron.edu
- 2015 - Ph.D. in Materials Science and Engineering, Georgia Institute of Technology
- Hybrid functional materials; stimuli-responsive polymers; 2D layered materials; 2D polymers; 3D micro/nanofabrication; origami/kirigami folding; soft actuators and robotics; biosensing and bioelectronics.

EMERITUS FACULTY

Dr. Mukerrem (Miko) Cakmak, Distinguished Professor Emeritus

- 1984 - Ph.D. in Polymer Engineering, University of Tennessee

Dr. Chang Dae (Paul) Han, Professor Emeritus

- 1964 - Sc.D. in Chemical Engineering, Massachusetts Institute of Technology

Dr. Avraam I. Isayev, Distinguished Professor Emeritus

- 1970 - Ph.D. in Polymer Engineering, Institute of Petrochemical Synthesis, USSR Academy of Sciences, Moscow

Dr. Erol Sancaktar, Professor Emeritus

- 1979 - Ph.D. in Engineering Mechanics, Virginia Polytechnic Institute and State University

X. POLYMER ENGINEERING GRADUATE COURSES

600	Interfacial Phenomena in Soft Matter Intermolecular interactions, (De)Wetting, Adsorption, Adhesion and Friction, Colloidal Stability, Nucleation, Assembly Process	3 credits
601	Polymer Engineering Seminar Presentations of recent research on topics in polymer engineering by internal and external speakers.	1 credit
610	Polymer Engineering Analysis Quantitative analysis methods central to Polymer Engineering, with applications including materials flow, deformation, and characterization.	3 credits
611	Fundamentals of Polymer Structure Characterization Characterization of orientation, morphology, superstructure in polymers using x-ray, light scattering, birefringence, dichroism. Crystal-lography, unit cell determination.	3 credits
621	Rheology of Polymeric Fluids Experimental methods of determination of rheological properties of polymer melts, solutions, elastomers. Structure-flow behavior relationships, viscoelastic fluid theory, application to extrusion, fiber, film processing molding. Structure development in processing.	3 credits
622	Analysis and Design of Polymer Processing Operations I <i>Prerequisite: 621.</i> Mathematical modeling and engineering design analysis of polymer processing operations including extruder screws, injection molds, dies, fibers, film formation.	3 credits
623	Analysis and Design of Polymer Processing Operations II <i>Prerequisite: Permission of instructor.</i> Basic studies on non-isothermal phenomena in polymer engineering emphasizing crystallization, vitrification, frozen-in orientation and residual stresses, applications, including fiber spinning and film extrusion.	3 credits
631	Engineering Properties of Solid Polymers Transitions as a function of polymer structure, optical characteristics, mechanical including ultimate properties, viscoelastic behavior of elastomers and plastics, large strain behavior emphasis on experimental methods.	2 credits
641	Polymer Chemistry and Thermodynamics Physioco-chemical properties of amorphous and crystalline polymers. Glass transitions, crystallization, molecular orientation and morphology of important commercial polymers, fabricated products and composite materials.	3 credits
650	Introduction to Polymer Engineering Basic concepts of polymer engineering taught in lecture-laboratory format intended for orientation of new graduate students.	3 credits
651	Polymer Engineering Laboratory <i>Prerequisite: 622.</i> Rheological characterization of polymer melts, rubber and plastic extrusion, extrudate swell, injection and compression molding, crystallization behavior, x-ray diffraction, film blowing, impact and tensile testing.	3 credits
661	Polymerization Reactor Engineering Polymerization kinetics, classical reactor design, comparison of polymerization in batch and continuous stirred tank reactors, flow patterns around agitators, tubular reactors, reactor stability.	3 credits

666	Research Methods This course will focus on providing guidance to beginning graduate students on general concepts that are typically encountered in research including, 1) scientific method; 2) ethics in research; 3) scientific paper writing; and 4) scientific presentations.	3 credits
675	Carbon-Polymer Nanotechnology <i>Prerequisite: permission of instructor.</i> This course focuses on the fundamental aspects of nanotechnology in general and basic knowledge of polymer/carbon nanoscience and nanotechnology in particular.	3 credits
680	Polymer Coatings <i>Prerequisite: Permission of instructor.</i> This course is an introduction to coating science. The synthesis of polymeric binders and pigments used in commodity coatings will be the focus of the first part of the course. The second part of the course will focus on coatings formulation and end-use applications for commodity coatings.	3 credits
699	Master's Research <i>May be repeated.</i> Supervised original research in specific area of polymer engineering.	1-6 credits
712	Rheo-Optics of Polymers Applications of rheo-optical methods as means of determining stress fields in polymeric glasses and fluids during deformation, rheo-optical properties of polymers in glassy, rubbery and fluid states. Theory of dynamic birefringence and its application to mechanical relaxations of amorphous and semi-crystalline polymers, and recent experimental results.	2 credits
715	Advanced Characterization of Functional Polymers <i>Prerequisites: 611 and 623 or equivalent courses (with permission of instructor).</i> This course will focus on advanced structural and functional property characterization techniques including optical, electrical, magnetic, and others. A particular focus will be the influence of the history of polymer processing on these properties.	3 credits
720	Molecular Aspects of Polymer Rheology <i>Prerequisite: 621 or permission of instructor.</i> Molecular theory for concentrated solutions and melts of flexible homopolymers, molecular rheology of miscible polymer blends, block copolymers, and liquid crystalline polymers.	2 credits
721	Rheology and Processing Two-Phase Polymer Systems <i>Prerequisite: 622 or equivalent.</i> Particle-particle interactions, mixing devices and design, theoretical hydrodynamics of suspensions of rigid particles, experimental studies of rheological behavior, phenomenological theories representing suspension behavior, dispersion of droplets to form an emulsion, phase morphology development and rheological properties of blends.	2 credits
722	Advanced Modelling of Polymer Processing <i>Prerequisite: permission of instructor.</i> Modelling of processing operations including extrusion molding, fiber and film processing, computer-aided design.	2 credits
723	Rheology and Processing of Elastomers Interpretation of rheological properties and critical study and analysis of processing operations including behavior in internal mixers, screw extruders, die systems and vulcanization molding.	2 credits
724	Advanced Extrusion and Compounding Principles of operation and flow in single and twin-screw extruders, screw design, characteristics of internal mixers, analysis and simulation of flow.	2 credits

725	Chemorheology and Processing of Thermosets <i>Prerequisites: 621 or 622 or permission of instructor.</i> Rheological behavior of thermosets, vulcanization of rubbers, time-temperature-transition relationships in thermosets, reaction injection molding, compression/transfer molding, pultrusion.	2 credits
727	Advanced Polymer Rheology <i>Prerequisite: 621 or equivalent.</i> Second level course in non-linear constitutive equation for viscoelastic, viscoplastic, viscoelastic-plastic polymeric materials. Utility and applicability to polymer processing problems.	2 credits
728	Numerical Methods in Polymer Engineering <i>Prerequisites: 621, 622, 623, 631.</i> Basics of generally accepted numerical methods. Numerical problems in polymer solid mechanics and technological applications. Numerical problems in polymer fluid mechanics and polymer engineering. Commercial softwares.	3 credits
731	Stress Analysis of Polymers and Composites <i>Prerequisite: 631.</i> The design of rubber mounts, bearings and sandwich components with demonstration of finite element methods. Classical plates and shells theories with applications to composite structures.	2 credits
745	Liquid Crystals <i>Prerequisite: permission of instructor.</i> Structure of low molecular weight and polymeric liquid crystals, characterization, physical properties including optical properties, phase transitions, structure-property relationships, processing of polymeric species.	2 credits
747	Polymer Colloids <i>Prerequisite: permission of instructor.</i> Colloidal dispersions, phase stability, aggregation structures, thermodynamics, kinetics of phase transitions in polymer colloids. Emulsion and solution polymerization, organic/inorganic hybrid materials, coating technology. Rheology of colloidal polymers.	3 credits
749	Phase Transitions in Polymer Blends and Alloys <i>Prerequisite: permission of instructor.</i> Elucidating thermodynamics of polymer blends, block copolymers, crystalline/liquids crystalline polymers, and kinetics of phase transitions. Structure development and modeling of reactive polymer blends.	3 credits
761	Injection and Compression Molding Fundamentals <i>Prerequisite: permission of instructor.</i> This course provides fundamental knowledge in physical, thermal and rheological properties required for injection and compression molding including theoretical and experimental aspects of various molding processes.	2 credits
770	Polymer Nanocomposites <i>Prerequisite: permission of instructor.</i> Develops understanding on synthesis, characterization, processing and properties of polymer nanocomposite materials involving nanoscale fillers in conjunction with thermosetting, thermoplastic, and elastomeric polymer matrices.	3 credits
773	Advanced Polymer Coating Technology <i>Prerequisites: 641 or equivalent or permission of instructor.</i> The polymeric binders used in radiation-curable coatings, coatings for electronic packaging and waterborne coatings will be stressed. The chemistry of dyes and the coatings science of pigments will be presented. The chemistry of polymer degradation will also be covered.	2 credits

- 777 Modeling of Nanoscale Materials** **3 credits**
Prerequisite: permission of instructor.
Introduces molecular simulation methods (Monte Carlo, molecular dynamics) and their application to polymer-related materials at the molecular and coarse-grain levels.
- 778 Advanced Functional Polymers** **2 credits**
Prerequisites: 611, 641 or permission of instructor.
This course focuses on the recent development of functional polymers for applications as advanced materials and smart devices, which requires the attendant to possess some prior knowledge of polymer science and polymer engineering from such 600-level course(s) as mentioned above.
- 797 Advanced Topics in Polymer Engineering** **2-3 credits**
Prerequisite: permission of instructor.
May be repeated.
Advanced special topics.
- 898 Preliminary Research** **1-15 credits**
May be repeated.
Preliminary investigation of Ph.D. dissertation subject.
- 899 Doctoral Dissertation** **1-15 credits**
May be repeated.
Original research by a Ph.D. student.