

SPECIAL REPORT
of the
GRADUATE COUNCIL
concerning a
GRADUATE CERTIFICATE
IN
SOFT MATERIALS FOR LIFE SCIENCES –
NATIONAL RESEARCH TRAINEESHIP (SMLS-NRT)

Presented at the
769th Regular Meeting of the Faculty Senate
May 4, 2017

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Through an electronic vote conducted on Thursday, April 20, 2017, the Graduate Council unanimously approved the Graduate Certificate in Soft Materials for Life Sciences – National Research Traineeship (SMLS-NRT), Proposal #3667 in the Course and Curriculum Management System.

MOTION: That the Faculty Senate approve the Graduate Certificate in Soft Materials for Life Sciences – National Research Traineeship (SMLS-NRT), as presented in Sen. Doc. 31-17 No. 17-078.

Briefly describe the certificate.

The NRT Program in Soft Materials for Life Sciences engages faculty and students at the University of Massachusetts Amherst in exploring a new graduate education model for training students in T-shaped skills--capability for breadth across professional skill areas and other technical areas, and depth in one area of specialization--that will serve master's and doctoral students well in the science and engineering workforce after graduation. The program will take 74 students in the disciplines of polymer science and engineering, immunology, food science, and several engineering fields through a multi-year training program, including awards of one-year NRT training stipends to 28 students. The research theme of applying polymeric materials to technical challenges in the life sciences such as drug delivery methods and personalized health monitoring devices enables an excellent ground for meaningful interdisciplinary collaboration. The project outcome will be a demonstrated, well-evaluated model for transformative graduate training that is effective in developing T-shaped professionals.

Provide a brief overview of the process for developing this certificate.

In 1997, NSF created the IGERT program in response to an escalating need for traditional, single-discipline graduate education to be augmented with interdisciplinary training. More than 80 faculty and graduate students from more than 10 departments and graduate programs participated in the IGERT program, including 17 NSF-funded fellows earning \$30,000 annual stipends. In 2015 that program was replaced by the NSF-funded NRT program, designed to encourage the development and implementation of bold, new potentially transformative and scalable models for STEM graduate education training. Such training provides emerging scientists, engineers, and educators with the multi-discipline background, deep knowledge in chosen disciplines, and technical, professional, and personal skills to become leading researchers and agents of change. Inherently interdisciplinary and well positioned with diverse intellectual strength, UMass Amherst was selected for a \$2.5 million NRT award in the fall of 2015. Securing a Graduate Certificate in Soft Materials for Life Sciences directly addresses a gap in graduate education and positions the University to secure additional research training grants in the future.

Describe the certificate's purpose and the particular knowledge and skills that will be acquired by participating students.

The University demonstrates a strong reputation for graduate education at the interface of engineering and the life sciences through such departments as biochemistry and molecular biology, biology, chemical engineering, chemistry, microbiology, physics, polymer science and engineering, food sciences and veterinary and animal sciences. Advances in graduate education highlight the importance of interdisciplinary training programs to enhance traditional, single-discipline graduate education. Supported by a grant from the National Science Foundation, the NRT program provides graduate students with interdisciplinary training in soft materials, a newly emerging field at the crossroads of engineering and the life sciences.

The educational program design features an intensive "Year Two Experience" that combines an interdisciplinary course in technical topics related to the research theme, professional development workshops and training activities, and interdisciplinary lab training modules. Students will also take a graduate course in scientific and engineering management, attend a seminar series featuring invited speakers and NRT trainee presentations, and take an elective associated with the program. Completing all requirements will earn the student a Graduate Certificate in Soft Materials for Life Sciences. This model is designed to facilitate a superior graduate training experience for both M.S. and Ph.D. students, while not adversely impacting time-to-degree. The research theme, from which collaborative research projects are able to spring, features two primary concentrations: Con 1 - Engineering Immunological Soft Materials (enabling immunologists to collaborate with polymer specialists) and Con 2 - Materials for Sensor Monitoring (supporting collaborations between engineers

and polymer scientists). A science-of-science study conducted throughout the NRT project will explore the dynamics and efficacy of interdisciplinary collaboration by students in this program.

This proposal outlines a Graduate Certificate in Soft Materials that will be available to graduate students currently matriculated in a graduate program. Our program builds on existing interdisciplinary programs and establishes two new interdisciplinary training concentrations – Engineering Immunological Soft Materials (Con1) and Materials for Sensor Monitoring (Con2) – that allow life science students and engineers, respectively, to train together with students specializing in polymer science and engineering. The dual-concentration model allows trainees to prepare for problem-solving careers in areas such as drug/nutraceutical delivery and biomedical devices/health monitoring, providing them flexibility and breadth of cross-disciplinary research and education for T-shaped development.

A summary table illustrating curricular requirements can be found in Appendix A.* This SMLS Graduate Certificate requires 12 credits plus lab modules and professional development training. Curricular components include:

- i. **NRT required courses (total of 5 credits):** Foundations of Soft Materials for Life Sciences I and II (PSE 797NR, 2 credits each for a total of 4 credits): Team-taught by Carter and Tew with important teaching roles for all Core Participants, the Core Course includes technical content. Presented over a one-year period (Foundations I is a 2-credit Fall course; Foundations II is a 2-credit course in the Spring), the Core Course is an integrated interdisciplinary curriculum (see Appendix B* for faculty listing). A Syllabus is provided in Appendix C.* Additionally, team-taught by Tew, Crosby and Watkins, NRT students are also required to take Scientific and Engineering Management (PSE 797D for 1 credit).
- ii. **Elective courses (3 credits):** Providing depth to the T-shaped training experience, a series of elective classes will be offered to extend Trainee expertise in a domain of their choice. Elective courses approved by the NRT Executive Committee will be aligned with the SMLS research and education theme, and one elective from the approved list will be required for NRT Trainees seeking to complete the Traineeship program. Trainees will be encouraged to select an elective that expands their domain expertise within their chosen concentration (Con1 and Con2). For example, a PSE Ph.D. student whose research is aligned with Con2 may be encouraged to take EE602, while a Veterinary and Animal Sciences (VASCI) Ph.D. student may take PSE501. At the same time, programmatic flexibility encourages students who develop a strong passion to deepen their training along a specific line (for example, a deep dive into science policy). Some courses available now are listed below; other new courses may be developed and introduced during the five-year NRT award period. Examples of elective courses can be found in Appendix A.*
 - a. One Life Sciences elective (3 credits) or
 - b. One Engineering/Physical Sciences elective (3 credits)
- iii. **Seminars (total of 4 credits, 1 credit each over 4 semesters):** Both Entrants and Trainees will be expected to attend Life Sciences-related seminars on a weekly basis for a total of 13 seminars per semester. Students will then be asked to submit a brief write-up on each seminar they attend. Students are encouraged to seek out topics and speakers who address various life science-related issues, including those outside of their own research. Guest speakers are invited from academia, industry, and government agencies and create more opportunities for students to expand on the T-shaped training paradigm of the NRT and to provide students with deeper insight for understanding the broader societal implications of the NRT theme. The NRT Student Leadership Council will work on inviting speakers and those receiving the NSF Fellowships will be expected to take a leadership role in hosting these professionals. Whenever possible, some guest speakers will be asked to provide some formal time during their visits for interactions with students. Examples of seminars can be found in Appendix A.*

iv. **Lab Modules (not credit hour based):** Ph.D. Trainees will be required to complete 4 out of 10 lab modules; M.S. Trainees complete 6 out of 10. Each is structured to provide critical hands-on experience with equipment and techniques beyond the Trainee's core domain expertise. These modules teach essential skills, especially for M.S. students who typically have less exposure to varied instrumentation. Lab modules are designed to teach a skill or set of skills. Due to the variable nature of instrumentation, lab modules are not assigned to credit hours since some are able to provide the skill set over a few hours, while others require more than one meeting. Students may complete these lab module hours over their entire Ph.D. career. Examples of lab modules can be found in Appendix A.*

v. **Professional Development Training (not credit hour based):** In carrying out the professional development training components of the SMLS curriculum, we rely heavily on a partnership with the new Office of Professional Development (OPD) within the UMass Amherst Graduate School. OPD, which was recently founded, provides a rich curriculum of training for all graduate students that individuals currently access on their own initiative. In our NRT program partnership, we make selected workshops and training modules from this training curriculum a defined and required part of the NRT Trainee's "course of study," thereby going beyond what has been done thus far at our institution and pointing the way toward a more "whole-student" approach to graduate education. Students are encouraged to develop their own training curriculum; to develop expertise in an area of their own passion. Students may complete these professional development hours over their entire Ph.D. career. Examples of professional development opportunities can be found in Appendix A.*

If this proposal requires no additional resources, say so and briefly explain why. If this proposal requires additional resources, explain how they will be paid for. For proposals involving instruction, indicate how many new enrollments are expected and whether the courses have room to accommodate them.

The Graduate Certificate proposed is based entirely on existing resources. It draws from existing courses, faculty, and administrative assistance already available across campus, and does not require additional funding for implementation.

Please describe the curriculum for this certificate, listing all required courses and possible electives, any prerequisites or GPA requirements, the recommended order or coursework and any other pertinent information. You may attach additional materials related to the curriculum at the end of this section.

Year Two Experience (Y2X). The Year Two Experience is a distinctive feature of the SMLS graduate traineeship program. It is designed to accommodate both Master's and Doctoral students (recognizing the shortened time frame for M.S. students).

Year Two Experience Components for Master's Students and Doctoral Students*:

1) Attend Foundations of Soft Materials for Life Sciences I (Core Course offered in Fall) - 2 credits; and Foundations of Soft Materials for Life Sciences II (Core Course offered in Spring) - 2 credits, Trainees; and attend Scientific and Engineering Management course (PSE 797D) offered in Spring - 1 credit, Trainees

2) Enroll in one Life Sciences-related Elective course(s) - 3 credits, Trainees.

3) Seminar Series - Attend 13 Life Sciences-related seminars and provide brief write up for each (4 semesters) - 1 credit per semester for a total of 4 credits, Entrants and Trainees.

4) Attend Interdisciplinary Lab Module Training, Ph.D. students are required to complete 4 lab modules; 6 for M.S. students. Each is structured to provide critical hands-on experience with equipment and techniques beyond the trainee's core domain expertise. These modules give essential skills, especially for M.S. students who

typically have less exposure to varied instrumentation. Fees for materials, staff and facilities for NRT student participation are provided for by NRT participant support funding from NSF, Trainees.

5) Attend Professional Development workshops/activities through Graduate School's Office of Professional Development - 36 contact hours for Ph.D.; 12 contact hours for M.S., Trainees (likely over a Trainee's entire Ph.D. career as opposed to squeezing into their first 2 years.)

6) Create Independent Development Plan (IDP), part of OPD and Professional Development, and review with Advisor; update and review document at end of Years 1 and 2, Entrants and Trainees.

See Appendix A* for examples of lab modules, electives and professional development activities acceptable for NRT credit.

Explain how these courses represent a coherent course of study.

These courses were designed to provide the underlying knowledge needed for graduate students to become professionals in the emerging area of soft materials for life sciences. The courses also provide a coherent approach to teaching important skills focused on communication.

Describe how there is a clear educational objective that can be achieved in an efficient and well-defined manner.

The curriculum was designed around the NSF training grant focused on soft materials for life sciences. The leading faculty designed the curriculum with care related to delivering the needed knowledge and time commitments for the students.

Explain how the course sequence offers a clear objective at the appropriate educational level.

The curriculum is designed with multiple components to achieve the outlined objectives including seminar attendance, Foundations I and II course, Scientific and Engineering management course, lab modules and integration of skills from the Office of Professional Development.

Describe the perceived need for this certificate.

Given the emergence and investment in IALS, along with the peer-reviewed and funding NSF training grant, the perceived need is high.

If the courses that comprise the certificate have been or currently are being offered, describe their schedule of availability. If the certificate is comprised of new courses, describe their planned availability.

See attachments*

If the certificate requires or includes courses from outside the sponsoring department, provide evidence of agreement(s) with the unit(s) offering those courses. You may attach any memoranda of understanding below.

There are many courses that are already offered in UMass Amherst STEM departments that may qualify for NRT credit.

If the requirements for this certificate overlap with those of another certificate or a degree program, describe that overlap.

(Note that if a student who has completed a certificate seeks clearance for a degree program that overlaps with that certificate program, the Registrar will note on the transcript that the certificate has been superseded by the degree.)

No overlap.

What type of student is allowed to participate in this certificate program? (e.g., matriculated UMass students, non-matriculated CPE students, Five College students, graduate students, students in a specific degree program, etc.)

Any student already enrolled in a doctoral program track in a UMass Amherst engineering, life sciences, or physical sciences program will be eligible to pursue the Graduate Certificate in Soft Materials for Life Sciences. However, the certificate will not be offered as a stand-alone entity, apart from a doctoral degree-granting program.

What role will this certificate play in relation to other departments or degree programs on campus? Certificates vary widely across campus and may represent a subset of an existing degree program, a multidisciplinary program, or an entirely free-standing area of focus.

This new certificate is more or less independent of other department and/or degree programs. Of course the students will be from other programs and the curriculum was designed in an effort to complement their primary course requirements from their home departments.

Is this a transitional certificate program?

(Transitional certificate programs are comprised of core courses from specific degree programs and may act as stepping stones into those programs. If a student who has completed a transitional certificate matriculates to the University and completes the degree program associated with that certificate, the transcript will note that the certificate has been superseded by the degree.)

No.

**For all attachments listed below, please refer to Proposal #3667 in the Course and Curriculum Management System.*

Appendix A

Appendix B

Appendix C

NRT Student Participation Agreement

NRT Cohort Checklist of Requirements

IDP Pilot Template

NRT Foundations II Spring 2016 Lecture Schedule

NRT Foundations I Fall 2016 Lecture Schedule

NRT Foundations II Spring 2017 Lecture Schedule