

From: noreply@wsu.edu
To: [curriculum.submit](#)
Subject: 764902 Graduate School Requirements New : Add Graduate Certificate
Date: Wednesday, August 30, 2023 11:40:53 AM
Attachments: [Form.html](#)
[IRAS Certificate Proposal Final.pdf](#)

Prashanta Dutta has submitted a request for a major curricular change. His/her email address is: prashanta@wsu.edu.

Request (from selection dropdown): Add Graduate Certificate

Department: Graduate School

New Graduate Certificate: Interdisciplinary Robotics and Autonomous Systems

CIP Code: 14.4201

Requested Effective Date: Fall 2024

Campus: Pullman, Tri-Cities, Vancouver,

Dean: Barry, Tammy - Vice Provost - Graduate and Professional Education

Chair: Sahaym, Arvin – Assoc. Vice Provost – Interdisciplinary

Catalog Subcommittee
Approval Date

AAC, PHSC, or GSC
Approval Date

Faculty Senate
Approval Date

From: [Sahaym, Arvin](#)
To: [curriculum.submit](#); [Barry, Tammy](#)
Subject: RE: 764902 Graduate School Requirements New : Add Graduate Certificate
Date: Wednesday, August 30, 2023 3:52:28 PM

Thank you. My opinion is as follows:

1. I approve this proposal in its current form.

Arvin

From: curriculum.submit@wsu.edu <curriculum.submit@wsu.edu>
Sent: Wednesday, August 30, 2023 11:36 AM
To: Sahaym, Arvin <arvin@wsu.edu>; Barry, Tammy <tammy.barry@wsu.edu>
Subject: 764902 Graduate School Requirements New : Add Graduate Certificate

Sahaym, Arvin – Assoc. Vice Provost – Interdisciplinary,

Barry, Tammy - Vice Provost - Graduate and Professional Education,

Prashanta Dutta has submitted a request for a major curricular change.

Request (from selection dropdown): Add Graduate Certificate

Department: Graduate School

New Graduate Certificate: Interdisciplinary Robotics and Autonomous Systems

CIP Code: 14.4201

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Campus: Pullman, Tri-Cities, Vancouver,

Both Chair and Dean approval is required to complete the submission process. Please indicate that you have reviewed the proposal by highlighting one of the statements below and **reply all** to this email. (curriculum.submit@wsu.edu.) [Details of major change requested can be found in the attached supplemental documentation]

1. I approve this proposal in its current form.

2. I approve this proposal with revisions. Revisions are attached.

3. I do not approve this proposal. Please return to submitter.

If you do not respond within one week, you will be sent a reminder email. If no

From: [Barry, Tammy](#)
To: [curriculum.submit](#)
Cc: [Sahaym, Arvin](#)
Subject: RE: 764902 Graduate School Requirements New : Add Graduate Certificate
Date: Tuesday, October 24, 2023 1:34:13 PM
Attachments: [image001.png](#)

Blaine,

I **approve** this certificate to be under the Graduate School. The delay was an oversight – thank you for following up!

Tammy

--

Tammy D. Barry, Ph.D.
Vice Provost for Graduate and Professional Education
Professor, Department of Psychology
Washington State University
Pullman, WA 99164
(509) 335-7008

From: curriculum.submit <curriculum.submit@wsu.edu>
Sent: Tuesday, September 19, 2023 9:31 AM
To: Barry, Tammy <tammy.barry@wsu.edu>
Cc: Sahaym, Arvin <arvin@wsu.edu>
Subject: FW: 764902 Graduate School Requirements New : Add Graduate Certificate

Hi Tammy,

I do not see that we received your approval for the new graduate certificate proposal. Please let me know if we can proceed with the Senate approval process.

This is an interdisciplinary program and in the past the “Dean” of the Graduate School has provided the approval statement. If you prefer these to go to someone else let me know and I’ll get it re-routed.

Thank you,
Blaine



Blaine Golden, MBA

Assistant Registrar
Office of the Registrar
Washington State University
Office: 509-335-7905
Email: bgolden@wsu.edu
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Proposed Graduate Certificate Program

Title of Certificate

Interdisciplinary Robotics and Autonomous Systems (IRAS)

Contact Information

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Table of Contents

Rationale for Certificate Program	2
Student Learning Objectives	3
Admission Requirements	3
Certificate Requirements	3-5
Participating Faculty and Resources	5
Administration and Oversight	5-6
Advertisement	6
Assessment	6-7

Rationale for Certificate Program

Robotics professionals of the future require more than just knowledge of technical design solutions to help address the grand challenges of the future work at the human-technology frontier; equally important is considering the *employee populations* affected by the increasing incorporation of robots into the workplace (e.g., social justice and equity implications of technology-induced obsolescence), *entrepreneurial skills* to bring innovation to practice, and the need to address the user experience through *adaptive design* of the human-robot interface. Leveraged by a newly awarded \$3M NSF Research Traineeship grant (dubbed NRT-LEAD for *NextGen Robotics Traineeship in Leadership, Entrepreneurship, and Adaptive Design*), the ***Interdisciplinary Robotics and Autonomous Systems (IRAS) graduate certificate program*** will provide convergent robotics training that addresses these challenges to future STEM professionals.

Most leading robotics programs understandably focus on the development of strong technical skills in the primary areas of engineering, mathematics, and computer science. However, the IRAS graduate certificate program also incorporates the *human-technology frontier* to address both technical and societal needs by having a convergent multi-disciplinary approach to training future robotics scientists, practitioners, and entrepreneurs in the design, implementation, and implications of NextGen robotics applications within agricultural, nuclear, and underwater settings. Earning the IRAS graduate certificate will allow engineering education to go beyond technical design challenges by incorporating a focus on the *inclusive leadership* role that NextGen roboticists can play in the human-technology frontier, the *entrepreneurial skills* needed to innovate business solutions, and the problem-based understanding needed to address the *socioeconomic and user implications arising from design decisions*.

The IRAS graduate certificate program incorporates faculty with expertise in engineering, science, entrepreneurship (business), occupational health, safety, and well-being (psychology), and equity and social justice (leadership) to provide convergent training to students in multiple graduate programs at WSU (e.g., M.S. and Ph.D. programs in Biological Systems Engineering, Computer Science, Electrical Engineering, Mechanical Engineering, and Materials Science & Engineering). Specifically, the IRAS certificate focuses on leadership, entrepreneurship, and adaptive design so that graduates will gain professional leadership training that addresses the equity and justice implications of increasing automation and incorporation of robots into the workplace, gain exposure to the business environment and learn how to translate innovations into viable products, and develop a deeper understanding of the user experience that is critical for informing product design, thereby facilitating greater acceptance by employees working alongside NextGen robots and the technicians operating the robots.

Students will apply their training to the areas of fruit orchard automation, nuclear waste cleanup, and underwater manipulation, as these are industry settings that address unique workforce demands related to labor shortages (agriculture), life-threatening hazardous working conditions (nuclear), and humanly inaccessible environments (underwater). In doing so, the IRAS program establishes multidisciplinary training focused on the common goal of pushing the boundary of next generation robotics to address grand challenges in the future of work by advancing the design and implementation of robotic technologies that operate in harmony with human workers and explore ways of mitigating potential risks, including inequity arising from future work at the human-technology frontier.

The IRAS certificate will provide the next generation of researchers with essential skills to design, develop, and employ various applications of autonomous and robotic technologies for (i) cleanup, restoration, and monitoring of nuclear wastes in dangerous radioactive environments, (ii) robotic harvesting, pruning, thinning, and pollination technologies in orchards and farms facing workforce shortages, and (iii) inspection, monitoring, repair, and maintenance in the underwater domain where human operations are difficult. In addition, the IRAS certificate program will bring project benefits to the rural farming community by addressing the labor shortage in the agricultural sector through advancing robotic technologies that provide a safe and equitable working environment while maintaining productivity in harsh working conditions. Through immersive field studies and community engagement experiences, students will gain entrepreneurial market skills, as well as greater insights into highlight how NextGen

robotics can be designed to help protect worker's health and safety in farming and nuclear waste cleanup (e.g., minimizing exposure via remote operation of machines).

Student Learning Objectives

Upon meeting all required elements of the IRAS graduate certificate, the student will have acquired the following skills and knowledge:

1. Demonstrate technical mastery in general robotics and autonomous systems through relevant coursework and technical components.
2. Appreciation of a multidisciplinary approach to robotics through seminar series for development of T-shaped graduates with depth and breadth of expertise.
3. Ability to work in a team, in collaboration with diverse others, to solve complex real-world problems.
4. Understand the socioeconomic impacts of new robotic and autonomous systems technology for workers and other affected populations.
5. Foster a culture of innovation and entrepreneurship to reap the benefits of new technology.
6. Develop oral and written communication skills to present scientific ideas, hypotheses, and design solutions.
7. Consider critical ethical issues surrounding technical design and integrate ethical solutions into technical designs.
8. Value equity, inclusion, and social justice in research and problem solving.
9. Exhibit deeper understanding of different cultures and the business operations from these cultures.

Admission Requirements

The certificate program is open to current graduate students of any STEM discipline who have goals and interests that align with the certificate program. Students can pursue the certificate during any phase of their training as long as there is sufficient time to complete the requirements. It is expected that it will take approximately two years to complete all the requirements of the certificate, which students will need to coordinate with WSU and their current Master's or PhD program requirements. Students will need to have a graduate GPA of 3.0 or better in order to participate in the program.

Certificate Requirements

Students earn the IRAS certificate via a combination of 10-credits of interdisciplinary and technical skills coursework, participation in IRAS seminars, completion of an immersive real-world field study experience, and completion of critical professional development activities. Additional mentoring, teaching, conference, internship, and community engagement opportunities will be offered as part of this program. Below are details regarding the five certificate requirements.

Note: The special topics courses (HBM 496 [1 cr.] and Psych 508 [1 cr.]) will be used to deliver specialized coursework, respectively, in: Business Innovation, Technology, & Entrepreneurship and Psychological Principles of User Experience Design. All Technical Skills advanced topics (i.e., Linear Control Systems, Estimation, and Identification; Soft Robotics; Modern Control Systems; and Autonomous Systems) will be delivered as 3 cr. courses using the ME 579, EE 582, and MSE 503 prefixes. This will result in a total of 10 credits required.

1. Coursework

Interdisciplinary Coursework (Complete all: 4 cr. total)	credit	var
		max
§ HBM 496 Special Topics	v, 1-6	6 max
§ Psych 508 Special Topics in Psychology	v, 1-3	

§ HD 505 Developing Effective Leadership: Tidal Leadership (2 cr.)	2
Technical Skills Coursework (Select 2: 6 cr. total)	
§ CPTS 543 Human-Computer Interaction	3
§ ME 581 Control Systems	3
§ ME 582 Robot Kinematics and Dynamics	3
§ ME 583 Machine Vision	3
§ BSYSE 530 Machine Vision for Biological Systems	3
§ CPTS 534 Neural Network Design & Applications	3
§ CPTS 540 Artificial Intelligence	3
§ CPTS 570 Machine Learning	3
§ Math 511 Advanced Linear Algebra	3
§ EE 501 Linear System Theory	3
§ ME 579 Advanced Topics in Mechanical Engineering	v, 1-3
§ EE 582 Advanced Topics	v, 1-3
§ MSE 503 Advanced Topics in Materials Engineering	v, 1-3 6 max

2. *Participation in IRAS Seminar Series*

All IRAS trainees will attend (either in person or virtually) at least *8 different seminars* during their time at the program. At the beginning of each semester, the executive committee will identify the appropriate seminar speakers from different disciplines, including Biological Systems Engineering, Chemical Engineering, Computer Science, Electrical Engineering, Materials Science & Engineering, and Mechanical Engineering.

3. *Attendance at Summer Workshop & Research Expo*

All IRAS trainees will participate in the Research Expo in order to showcase their research results and activities in front of an audience of academic mentors, peers, and industry partners. Poster and oral presentations will help trainees to develop the necessary skills for public speaking as well as communicating with a non-academic audience as they talk about their cutting-edge research impact on society and human life. Summer Workshops to develop the necessary skills for writing technical project reports, preparing a research poster, and making a research presentation will also be held during the Summer term.

4. *Completion of Professional Development Series*

This component leverages the existing WSU Professional Development Initiative (PDI) organized by the Graduate School and the GPSA. It offers a range of programs, training opportunities, and resources to prepare graduate students for academic and career success to ensure that all graduate students have the skills, knowledge, and mindset necessary to succeed. PDI currently offers more than 50 events throughout the academic year on *academic development, career development, professional skill development, and personal growth* covering all stages starting from early career to late career for student success. IRAS trainees will be required to participate in at least *five different professional development activities* over the first two years of their degree program.

5. *Participation in Immersive Field Study*

All trainees will participate in one *immersive field study* selected from three targeted industry areas. Trainees will choose from *one* of the following immersive field studies during their program.

- Workforce reactions to automation and incorporation of robots into agricultural settings: While there is clear industry demand for NextGen robots to assist with crop operations in tree fruit orchards, psychosocial barriers to human-robot collaboration remain. While new technologies, such as robots and autonomous systems, can dramatically increase productivity and decrease worker exposure to common agricultural risks (e.g., falls from heights), they risk exacerbating

work-related stressors and psychological distress of employees due to fears of obsolescence and technology-induced job insecurity. Immersive field research in this area will examine job-related attitudes and behavioral reactions to working alongside NextGen robots in agricultural settings. NRT fellows participating in the study will collect data to examine health, safety, and job attitudinal outcomes among workers in orchards with NextGen robots in order to gain a more comprehensive understanding of workforce psychosocial challenges that may otherwise impede the successful adoption of technical advancements.

- Using psychology to improve product design and the experience in nuclear settings: In addition to technical design advancements needed to accelerate the development and adoption of NextGen robots, NRT-LEAD fellows will engage in research to better understand psychosocial barriers and improve the user experience of the operating technicians. This second immersive study will address technical specification in the development of NextGen robots in nuclear settings with faculty expertise in occupational health psychology to identify optimal kinematics, dynamics, control, and planning of NextGen robots both from a technical design perspective as well as the user experience and associated psychosocial factors. NRT-LEAD trainees will develop a series of testable research hypotheses, implement qualitative and quantitative research methods to identify user needs and motivations, perform usability testing, and evaluate attitudinal and behavioral reactions to potential engineering design solutions.
- Market research to develop biomimetic robots for underwater applications: In this immersive field study and drawing from prior coursework on Business Innovation, Technology, and Entrepreneurship, NRT-LEAD fellows will conduct a market study of biometric robots used for underwater applications such as search, rescue, sensing, or repair. NRT trainees will review and learn several cases related to biometric robots, perform a market analysis, study customers' characteristics, and write a business plan for the biometric robots. This immersive market study will offer trainees a deeper understanding of market analysis, customers, internal and external environments, and business planning related to next-generation robotics.

Participating Faculty and Resources

The IRAS has faculty participating from four colleges, including Engineering, Arts and Sciences, Business, and Agricultural, Human, and Natural Resource Sciences.

Dr. Prashanta Dutta	Mechanical & Materials Engineering
Dr. Tahira Probst	Psychology
Dr. Manoj Karkee	Biological System Engineering
Dr. R. Scott Hudson	Engineering & Applied Sciences
Dr. Konstantin Matveev	Mechanical & Materials Engineering
Dr. Changki Mo	Engineering & Applied Sciences
Dr. Soobin Seo	Hospitality Business Management
Dr. Ming Luo	Mechanical & Materials Engineering
Dr. Xiaopeng Guo	Chemistry
Dr. N. Perez-Arancibia	Mechanical & Materials Engineering
Dr. Jeff D. Vervoort	Earth & Environmental Sciences
Dr. Julie Kmec	Sociology
Dr. Matthew Whiting	Horticulture
Dr. John Miller	Engineering & Applied Sciences
Dr. Kaiyan Qiu	Mechanical & Materials Engineering
Dr. John Swensen	Mechanical & Materials Engineering
Dr. Qin Zhang	Biological System Engineering
Dr. Mehdi Hosseinzadeh	Mechanical & Materials Engineering

Administration and Oversight

The NRT-LEAD program will sponsor the IRAS certificate and serve as the academic lead. The current administrative committee is listed at the top of the proposal and is responsible for the day-to-day operations of the program. The administrative committee will meet each term and membership will be

reviewed and amended as necessary. Members of the committee will coordinate the certificate across colleges and campuses, review applicants, run the workshops and research expos, coordinate administrative tasks, ensure oversight and satisfactory completion of students, and review any proposed changes.

Figure 1 details the organizational support structure, which includes oversight, support, and evaluation mechanisms. Notable is the program's independent External Advisory Committee (EAC) that is comprised of members representing all research themes (nuclear, agricultural, underwater) and application areas. Additionally, members will be appointed from our partner minority-serving institutes to help us with the recruitment and retention of students from under-represented minority (URM) populations. All EAC members will meet in person annually to provide independent reviews and give feedback and suggestions for program improvement.

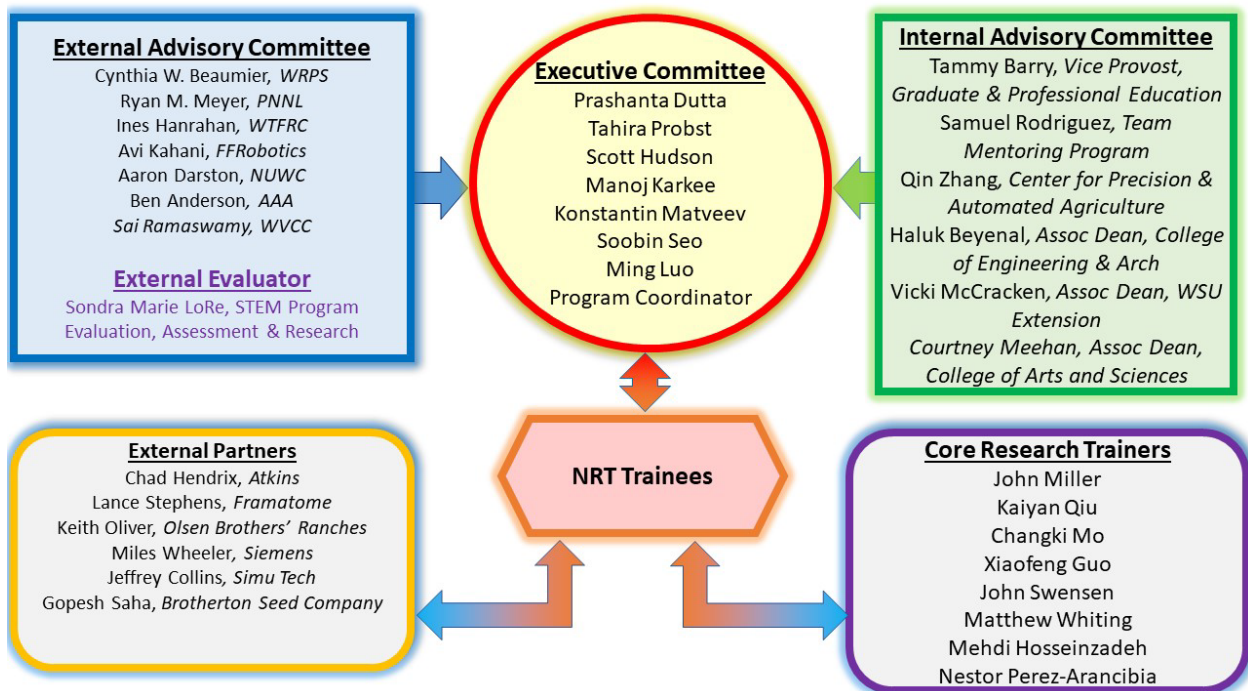


Fig. 1: The graduate certificate program will be coordinated by the executive (administrative) committee with the inputs from external evaluator, internal and external advisory committees, and trainees.

Advertisement

The IRAS graduate certificate advertisement mechanisms will include the participating faculty and colleges, a website dedicated to the program (<https://nrt-lead.nrt.wsu.edu/>), and programs targeted at URM students, as one of the key goals of the IRAS certificate program is to broaden the participation of URM in STEM through established programs, such as the Louis Stokes Alliance for Minority Participation (LSAMP), TRIO Student Success Support (SSS) program, and Society of Women Engineers (SWE).

Assessment

An external evaluator will conduct a comprehensive evaluation of the overall effectiveness and outcomes of the research and traineeship activities and integrate strategies for formative and summative feedback about program activities using qualitative and quantitative methods. This ongoing, comprehensive evaluation will align to intended program outcomes and be utilization-focused, emphasizing the use of data-driven decision making by program leadership for continuous program improvement. Regular communication with the leadership (executive/administrative committee) and advisory boards (both internal and external) will ensure data are interpreted appropriately and used formatively for program

improvement and summatively to measure progress toward goals. In this longitudinal mixed-methods approach, qualitative data will be analyzed using open and axial coding for thematic analysis, and quantitative data will be summarized using descriptive statistics and parametric or nonparametric statistical analyses when appropriate. Quantitative and qualitative data will be synthesized and analyzed with a convergent case study approach to understand how the program activities work together within their contexts to achieve program goals. Evaluation results will be disseminated to participants and broadly to the community through peer-reviewed publications and presentations at the national meetings.