5-5-2016

The Five Hundred and Thirty-Third Report of the Curricular Affairs Committee: Creation of a Minor in Robotics Engineering.

University of Rhode Island Faculty Senate

THE
UNIVERSITY
OF RHODE ISLAND
FACULTY SENATE OFFICE
Green Hall, 35 Campus Avenue, Kingston, RI 02881 USA p: 401.874.2616

THINK BIG WE DO

Serial Number #15-16—35E

TO: President David Dooley
FROM: Joëlle Rollo-Koster, Chairperson of the Faculty Senate

1. The attached BILL titled, The Five Hundred and Thirty-Third Report of the Curricular Affairs Committee: Creation of a Minor in Robotics Engineering is forwarded for your consideration.

2. This BILL was adopted by vote of the Faculty Senate on May 5, 2016.

3. After considering this bill, will you please indicate your approval or disapproval. Return the original, completing the appropriate endorsement below.

4. In accordance with Section 10, paragraph 4 of the Senate's By-Laws, this bill will become effective May 26, 2016 three weeks after Senate approval, unless: (1) specific dates for implementation are written into the bill; (2) you return it disapproved; or (3) the University Faculty petitions for a referendum.

Joëlle Rollo-Koster
Chairperson of the Faculty Senate

May 5, 2016

ENDORSEMENT

TO: Chairperson of the Faculty Senate

FROM: President of the University

a. Approved ____.

b. Approved subject to Notice of the Council on Postsecondary Education ✓.

c. Disapproved ____.

Recognized 6/22/16

Signature of ~~the~~ President

5.18.16
(date)

THE
UNIVERSITY
OF RHODE ISLAND
FACULTY SENATE OFFICE

THINK BIG WE DO

UNIVERSITY OF RHODE ISLAND FACULTY SENATE

May 5, 2016
Faculty Senate Curricular Affairs Committee
Five Hundred and Thirty-Third Report

At the April 25, 2016 meeting of the Curricular Affairs Committee and by electronic communication, the following matters were considered and are now presented to the Faculty Senate.

CURRICULAR CHANGES

B. COLLEGE OF ENGINEERING:

Creation of a Minor in Robotics Engineering: (see Appendix L)

Any engineering major may declare a "Minor in Robotics Engineering" field of study, which will be listed on the student's academic record after graduation. Requirements may be satisfied by completing 18 credit hours. Student must complete one of the following options, as well as an additional three courses (9 credits) from the list of supporting courses. The choice of option is not restricted by major.

Option 1, Ocean Engineering Focus: (9 credits)
Ocean Engineering: Robotic Ocean Instrumentation Design (OCE360)
Ocean Engineering: Design of Remotely Operated Vehicles (OCE467)
Math: Linear Algebra (MTH215)

Option 2, Mechanical Engineering Focus: (9 credits)
Mechanical Engineering: Computer Control of Mechanical Systems (MCE431)
Mechanical Engineering: Mechatronics (MCE433)
Math: Linear Algebra (MTH215)

Option 3, Electrical Engineering Focus: (9 credits)
Electrical Engineering: Digital Control Systems & Lab (ELE 458/459)
Electrical Engineering: Mobile Computing (ELE 470)
Math: Linear Algebra (MTH215)

Supporting Courses: (Choose 3 other courses - 9 credits total.)

Offered Fall Semester		
Electrical	Mobile Computing	ELE470
Mechanical	Mechatronics	MCE433
Ocean	Robotic Ocean Instrumentation Design	OCE360
	Hydrodynamics	EGR515

Offered Spring Semester		
Electrical	Microprocessors	ELE205/206
	Digital Control Systems & Lab	ELE458/459
	Computer Vision	ELE583
Mechanical	System Dynamics	MCE366
	Computer Control of Mechanical Systems	MCE431
	Real-Time Monitoring and Control	MCE530

	The Mechanics of Robot Manipulators	MCE566
Ocean	Design of Remotely Operated Vehicles	OCE467
	Biomimetics in Ocean Engineering	OCE516
	Modeling, Simulation, and Control of Marine Vehicles	OCE562
Oceanography	Modern Oceanographic Imaging and Mapping Techniques	OCG555

With prior approval, supporting courses may be substituted with appropriate other courses including special projects. Application for the robotics engineering minor must be filed in the Engineering Dean's Office any time before graduation.

THE
UNIVERSITY
OF RHODE ISLAND
Abbreviated Proposal RIBGHE

Appendix L

Revised 10-2009

A Proposal for the Creation of a Robotics Engineering Minor

A. PROGRAM INFORMATION

1. **Name of institution**
   University of Rhode Island

2. **Name of department, division, school or college**
   College of Engineering

3. **Title of proposed program and Classification of Instructional Programs (CIP) code**
   Minor in Robotics Engineering (14.9999 - Engineering, Other)

4. **Intended initiation date of program change. Include anticipated date for granting first degrees or certificates, if appropriate.**
   Initiation: September, 2016

5. **Intended location of the program**
   Kingston Campus and Narragansett Bay Campus

6. **Description of institutional review and approval process**

	Approval Date
Department	1/15/2016
College	3/9/2016
CAC/Graduate Council	
Faculty Senate	
President of the University	

7. **Summary description of proposed program (not to exceed 2 pages)**

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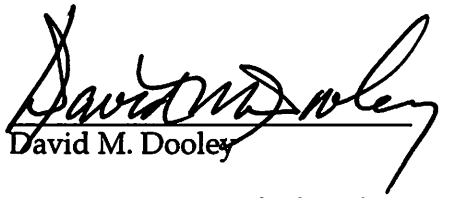
8. **Signature of the President**



David M. Dooley

9. **Person to contact during the proposal review**
Name: Stephen Licht
Address: 110 Sheets Building, Narragansett Bay Campus
Phone: (401) 874-6028
Email: slicht@egr.uri.edu

10. **Signed agreements for any cooperative arrangements made with other institutions/agencies or private companies in support of the program.**
None

B. **RATIONALE: There should be a demonstrable need for the program.**

1. **Explain and quantify the needs addressed by this program, and present evidence that the program fulfills these needs.**

There is a large regional and national demand for robotics engineering at the undergraduate level. One source of the demand is the increasing number of students in K-12 who are exposed to robotics through various extra-curricular competitions. Funding and support for these programs stems from a recognition that robotics at the K-12 level is an important gateway for matriculation in STEM fields and entry into STEM related careers.

The most prominent example is the FIRST Robotics Competition, in which teams of high school students paired with working engineers participate in local, regional, and national competitions by designing and building mobile robots. There are currently 44 FIRST robotics teams in Connecticut[1], 37 teams registered for the Rhode Island District competition[2], and more than 180 teams combined in Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island and Vermont.[3] Team size is typically more than 10 members, indicating a base population of nearly 2000 high school students regionally with a strong interest in robotics.

An evaluation of the program led by Brandeis University indicates that 89% of FIRST alumni report attending college. The report include the following notable statistics:

> *Seventy-seven percent of female FRC alumni were in college, 68% of African-American alumni, and 78% of Hispanic alumni – all above the national averages for those groups.*
>
> *Nearly 60% of FIRST alumni had at least one science or technology-related work experience (internship, apprenticeship, part-time or summer job). Thirteen percent received grants or scholarships related to science or engineering; and 66% reported receiving any kind of grant or scholarship.*
>
> *Women and minority alumni also majored in Engineering at comparatively high rates. Thirty-three percent of the female FRC alumni, 27% of the African-American alumni, and 47% of the Hispanic alumni reported majoring in Engineering (compared to national averages of 2%, 5% and 6% respectively).*

[1] http://www.firstct.org/our-programs/frc-high-school-ages/frc-teams-in-ct/
[2] http://www.usfirst.org/whats-going-on/event/10791/teams?ProgramCode=FRC
[3] http://www.nefirst.org/2015/01/13/ne-first-robotics-competition-teams-begin-2015-season-with-recycle-rush/

More than Robots: An Evaluation of the FIRST Robotics Competition Participant and Institutional Impacts[4]

To summarize, this is a diverse population of highly motivated, high quality students, who can be expected to factor the breadth and quality of robotics curriculum offering into their college decisions.

The value of robotics for attracting high quality undergraduates was the motivation for the introduction of a first in the nation 4-yr Robotics Engineering B.S. at Worcester Polytechnic Institute (WPI) in 2007. WPI is a regional competitor (>60% of the WPI class of 2018 is from New England[5]) for these students, and has also been successful in drawing students internationally and from across the US. Indeed, within four years, the major was one of the ten most popular programs at WPI[6], and as of 2013 there were 233 students enrolled[7].

> **"Why did you choose WPI?"**
> ***It is one of the few universities with a robotics engineering major, and it has a great reputation among businesses and other universities. (Narragansett, RI)***[8]
>
> ***One of the only robotics programs. Attended the WPI Frontiers summer program. Small school just far enough away. (South Hadley, MA)***[9]
>
> ***WPI was the only school at the time offering a degree in Robotics Engineering, and I received a full-tuition scholarship through my participation in FIRST. (South Windsor, CT)***[10]
>
> ***WPI was the first school to offer an accredited Robotics Engineering program. (Honolulu, Hawaii)***[11]
>
> ***I did more research, and turns out WPI also had Robotics Engineering, which was something I found very interesting! (Bangkok, Thailand)***[12]
>
> **Selected students quotes from the WPI Robotics Engineering website.**[13]

To attract these students, it is vital for URI to have a clearly articulated program of study, supported by faculty with diverse expertise within the discipline. The proposed Robotics Engineering Minor within the URI College of Engineering is designed to provide an

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[4] http://www.usfirst.org/uploadedFiles/Who/Impact/Brandeis_Studies/FRC_eval_execsum.pdf
[5] http://www.wpi.edu/admissions/undergraduate/perspective/teach-counselors.html
[6] http://www.wpi.edu/news/20112/rbeaccred.html
[7] http://www.wpi.edu/Images/Templates/IR/2013_Fact_Book_10-31-13.pdf
[8] http://www.wpi.edu/academics/robotics/jdorich.html
[9] http://www.wpi.edu/academics/robotics/daniel76.html
[10] http://www.wpi.edu/academics/robotics/tjwats29.html
[11] http://www.wpi.edu/academics/robotics/afung.html
[12] http://www.wpi.edu/academics/robotics/sarajp35.html
[13] http://www.wpi.edu/academics/robotics/our-students.html

attractive option to these students by providing a program rooted in hands-on, project based learning.

C. **INSTITUTIONAL ROLE: The program should be clearly related to the published role and mission of the institution and be compatible with other programs and activities of the institution.**

1. **Explain how the program is consistent with the published role and mission of the institution and how it is related to the institution's academic planning.**

The minor is being created following the COE Strategic Plan, which seeks to recruit a larger number of high quality undergraduates into the college by developing minors in strategically important disciplines (COE Strategic Plan, C7).[14] As evidence that there is long term institutional support for an increased focus on robotics, COE is currently in the process of hiring three tenure-track faculty (one each in Electrical, Mechanical, and Ocean Engineering) with robotics specializations. COE is also working closely with the Graduate School of Oceanography (GSO) to develop robotics offerings; GSO is currently in the process of hiring for a tenure-track faculty position in marine robotics with a commitment to teach courses within the Ocean Engineering Department.

D. **INTERINSTITUTIONAL CONSIDERATIONS: The program should be consistent with all policies of the Board of Governors pertaining to the coordination and collaboration between public institutions of higher education. (Consult the Board of Governors' *Coordination Plan for Academic Programs in Rhode Island Public Institutions of Higher Education* [www.ribghe.org/publicreg.htm] for guidelines and restrictions regarding the types and levels of programs the institutions are allowed to offer.)**

1. **Estimate the projected impact of program on other public higher education institutions in Rhode Island (e.g. loss of students or revenues), provide a rationale for the assumptions made in the projections, and indicate the manner in which the other public institutions were consulted in developing the projections.**

No significant impact is expected at other public higher education institutions; the proposed program does not add any course that overlap with offerings through CCRI or RIC. Students opting to pursue the minor may opt to fulfill the MTH215 (Linear Algebra) requirement with the corresponding course at RIC, MTH 315 (Linear Algebra).

2. **Using the format prescribed by RIOHE, describe provisions for transfer students (into or out of the program) at other Rhode Island public institutions of higher education. Describe any transfer agreements with independent institutions. The institution must also either submit a Joint Admissions Agreement transition plan or the reason(s) the new program is not transferable. (See *Procedure for Strengthening the Articulation/Transfer Component of the Review Process for New Programs* which can be found at *www.ribghe.org/publicreg.htm.*)**

[14] College of Engineering Strategic Plan, C7 <http://egr.uri.edu/wp-uploads/coe/EngineeringStrategicPlan.pdf>

Course-by-course transfer: The minor is administered within the College of Engineering, as any student within the College of Engineering may declare and complete the minor. As such, the procedure for transferring into, and transferring credits into, the program will fall under the existing course by course procedure administered by the COE Dean's office. Students do not need to declare the minor prior to taking courses that they wish to apply to the minor.

Program transfer: There are no program transfer agreements, nor are there plans to develop new transfer agreements. Any course in the minor which is accepted under the program transfer agreements for the students major department can be applied to the minor.

3. **Describe any cooperative arrangements with institutions offering similar programs. (Signed copies of any agreements pertaining to use of faculty, library, equipment, and facilities should be attached.)**
   None.

4. **If external affiliations are required, identify providing agencies. (Indicate the status of any arrangements made and append letters of agreement, if appropriate.)**
   None required.

5. **Indicate whether the program will be available to students under the New England Board of Higher Education's (NEBHE) Regional Student Program (RSP).**
   No

E. **PROGRAM: The program should meet a recognized educational need and be delivered in an appropriate mode.**

1. **Prepare a typical curriculum display for one program cycle for each sub-major, specialty or option, including the following information:**

   a. **Name of courses, departments, and catalog numbers and brief descriptions for new courses, preferably as these will appear in the catalog. In keeping with each institution's timetable for completion of student outcomes assessment, each institution should provide an assessment plan detailing what a student should know and be able to do at of the program and how the skills and knowledge will be assessed. For example, if a department brings forth a new program proposal but that department is not slated to have its student outcomes assessment completed until 2008, the program could be approved but with the provision that the department return no later than 2008 and present to the Academic and Student Affairs Committee its student outcomes for that particular program.**

      No new courses are proposed. The minor is composed of courses which are currently listed in the URI course catalog. Student outcomes will be assessed using existing tools for the individual courses elected by the students to complete the minor.

   b. **Required courses in area of specialization and options, if any.**

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Option 1, Ocean Engineering Focus: (9 credits)
Ocean Engineering: Robotic Ocean Instrumentation Design (OCE360)
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Math: Linear Algebra (MTH215)

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Mechanical Engineering: Mechatronics (MCE433)
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Electrical Engineering: Digital Control Systems & Lab (ELE 458/459)
Electrical Engineering: Mobile Computing (ELE 470)
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Supporting Courses: (Choose 3 other courses - 9 credits total.)

Offered Fall Semester		
Electrical	Mobile Computing	ELE470
Mechanical	Mechatronics	MCE433
Ocean	Robotic Ocean Instrumentation Design	OCE360
	Hydrodynamics	EGR515

Offered Spring Semester		
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	Digital Control Systems & Lab	ELE458/459
	Computer Vision	ELE583
Mechanical	System Dynamics	MCE366
	Computer Control of Mechanical Systems	MCE431
	Real-Time Monitoring and Control	MCE530
	The Mechanics of Robot Manipulators	MCE566
Ocean	Design of Remotely Operated Vehicles	OCE467
	Biomimetics in Ocean Engineering	OCE516
	Modeling, Simulation, and Control of Marine Vehicles	OCE562
Oceanography	Modern Oceanographic Imaging and Mapping Techniques	OCG555

With prior approval, supporting courses may be substituted with appropriate other courses including special projects.

c. **Course distribution requirements, if any, within program, and general education requirements.**

No additional distribution or general education requirements.

d. Total number of free electives available after specialization and general education requirements are satisfied.

No change.

e. Total number of credits required for completion of program or for graduation. Present evidence that the program is of appropriate length as illustrated by conformity with appropriate accrediting agency standards, applicable industry standards, or other credible measure, and comparability of lengths with similar programs in the state or region.

The minor can be completed by any engineering student with five (5) course that can be used as professional electives in the engineering majors, and one (1) math course that can be used either as a free elective in the engineering majors or as an additional course.

Students are required to complete four (4) professional electives for either the Mechanical or Electrical engineering major, and five (5) professional electives for the Ocean engineering major. All three majors include a free elective.

As result, the minimum number of credits to receive the robotics engineering minor can be compared to the minimum number of credits for each major as follows:

	Minimum credits for major	Minimum credits to receive robotics engineering minor.
Mechanical engineering	122	125
Electrical engineering	123	126
Ocean engineering	126	126

The majority of ABET accredited engineering programs in the United States require between 120 and 132 credit hours for completion of a major program. The credit hours to receive the minor within each department listed is well within the U.S. standard.

f. Identify any courses that will be delivered or received by way of distance learning. (Refer to *www.ribghe.org/publicreg.htm* for the *Standards for Distance Learning in the Rhode Island System of Public Higher Education.*)

None

2. Describe certification/licensing requirements, if any, for program graduates and the degree to which completion of the required course work meets said requirements. Indicate the agencies and timetables for graduates to meet those requirements.

None

3. **Include the learning goals (what students are expected to gain, achieve, know, or demonstrate by completion of the program) and requirements for each program.**

   Students are expected to gain fundamental knowledge required for the multi-disciplinary field of robotics, with an emphasis on the particular problems within their major engineering discipline. All students completing the major will be able to demonstrate:
   - practical working knowledge of linear algebra to solve systems of dynamic equations describing physical phenomena.
   - the ability to write, compile, and deploy software on computing hardware which can be used by modern robotic platforms to control, to sense, to model, and/or to react to the external world.
   - the ability to apply engineering design techniques to subsystems of robotic systems, and articulate the constraints, requirements, and roles of those subsystems as a function of the overall robotic system constraints and requirements.

4. **Demonstrate that student learning is assessed based on clear statements of learning outcomes and expectations.**

   Student outcomes will be assessed using existing tools for the individual courses elected by the students to complete the minor.

F. **FACULTY AND STAFF: The faculty and support staff for the program should be sufficient in number and demonstrate the knowledge, skills, and other attributes necessary to the success of the program.**

1. **Describe the faculty who will be assigned to the program. Indicate total full-time equivalent (FTE) positions required for the program, the proportion of program faculty who will be in tenure-track positions, and whether faculty positions will be new positions or reassignment of existing positions.**

All courses within the program are offered as of AY2015-16 by current faculty. No new faculty lines, adjunct faculty, or instructors are required to deliver any element of the program.

G. **STUDENTS: The program should be designed to provide students with a course of study that will contribute to their intellectual, social and economic well-being. Students selected should have the necessary potential and commitment to complete the program successfully.**

1. **Describe the potential students for the program and the primary source of students. Indicate the extent to which the program will attract new students or will draw students from existing programs and provide a specific rationale for these assumptions. For graduate programs, indicate which undergraduate programs would be a potential source of students.**

   The primary source of students will be undergraduate population of the College of Engineering, with most students beginning to take courses that can be counted towards the minor in the Fall of their third year. We expect that the minor will draw additional

students to the College of Engineering, given the growing regional and national demand for robotics programs documented above. As note above, the minor is being created following the COE Strategic Plan, which seeks to recruit a larger number of high quality undergraduates into the college by developing minors in strategically important disciplines (COE Strategic Plan, C7). [15]

L. EVALUATION: Appropriate criteria for evaluating the success of a program should be development and used.

1. List the performance measures by which the institution plans to evaluate the program. Indicate the frequency of measurement and the personnel responsible for performance measurements. Describe provisions made for external evaluation, as appropriate.

The program will initially be evaluated on a yearly basis by the faculty coordinators from the three disciplines corresponding to the three listed options: Electrical engineering, Mechanical engineering, and Ocean engineering. The faculty coordinators will compile a report for the COE Dean providing statistics including number of students who have completed the minor, number of current students who have declared the minor, and the breakdown of those numbers by department. Exit interviews will be solicited from students graduating with the minor by the faculty coordinators, to assess the level of student satisfaction with the program, and to assemble a database of student expected employment status at time of graduation. The report to the COE Dean will recommend changes to the program on a yearly basis, as needed to maximize student interest and optimize student outcomes.

[15] College of Engineering Strategic Plan, C7 <http://egr.uri.edu/wp-uploads/coe/EngineeringStrategicPlan.pdf>

UNIVERSITY OF RHODE ISLAND
COLLEGE OF ENGINEERING

ROBOTICS ENGINEERING MINOR (COE)

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UNIVERSITY OF RHODE ISLAND
COLLEGE OF ENGINEERING

ROBOTICS ENGINEERING MINOR (COE)

Name:_____ **Student ID #:**_____

Major:_____ **Intended Graduation Date:**_____

Name of Minor: Robotics Engineering

Course Number	Course Title	#Credits	Grade

_____ _____
Ocean, Mechanical, or Electrical Engineering Robotics Program Coordinator Signature — Date

_____ _____
Departmental Chairperson Signature — Date

_____ _____
Dean's Signature — Date

THE
UNIVERSITY
OF RHODE ISLAND

COLLEGE OF
ARTS AND SCIENCES

THINK BIG WE DO

DEPARTMENT OF MATHEMATICS
5 Lippitt Road, Room 200, Kingston, RI 02881 USA p: 401.874.2709 f: 401.874.4454 math.uri.edu

To Stephen Licht:

The mathematics department agrees to have the course MTH 215 Linear Algebra as part of this new exciting minor in robotics engineering. We offer several sections of MTH 215 in the Fall, Spring, and Summer semesters and can handle the modest increase in enrollment.

Best Regards,

James Baglama
Chair of Mathematics
Department of Mathematics
University of Rhode Island
Kingston, RI 02881
Office: Lippitt Hall 200D
Phone: 401.874.4412
Email: jbaglama@uri.edu