WORCESTER POLYTECHNIC INSTITUTE
December 10, 2020

To: The WPI Faculty
From: Tanja Dominko
Secretary of the Faculty

The third Faculty meeting of the 2020-2021 academic year will be held on **Thursday, December 10th, 2020 at 3:15 pm via ZOOM**.

1. Call to Order
   - Approval of the Agenda
   - Approval of the Consent Agenda ~~and the Minutes from 11-5-20~~
2. Secretary of the Faculty Report
3. A Belated and Brief Convocation – Announcement of Trustee Awards from April 2020
4. Committee Business
   - **Committee on Academic Operations**
     Motion to approve graduation list of undergraduate students eligible to receive a degree in January 2020
   - **Committee on Graduate Studies and Research**
     Motion to approve graduation list of undergraduate students eligible to receive a degree in January 2020
   - **Committee on Governance**
     Motion to establish Department of Integrative and Global Studies (DIGS)
   - **Committee on Graduate Studies and Research**
     1. Motion for MS program in Community Climate Adaptation (MS-CAA)
     2. Motion for BS/MS program in Community Climate Adaptation
     3. Motion to approve IGS course prefix
     4. Motions to approve new courses in DIGS
     5. Motion to establish a new Master of Science program in Cybersecurity (MS-SEC)
     6. Motion to establish a new Master in Computer Science program (MCS)
     7. Motions to approve new CS courses
5. President's Report
6. Provost's Report
7. New Business
8. Closing Announcements
9. Adjournment

WORCESTER POLYTECHNIC INSTITUTE
Faculty Meeting Minutes
October 1, 2020

The third Faculty meeting of the 2020-2021 academic year was held on **Thursday, November 5th, 2020 at 3:15 pm via ZOOM**.

10. Call to Order
    - Approval of the Agenda
    - Approval of the Consent Agenda and the Minutes from 10-1-20
11. Secretary of the Faculty Report
12. Committee Business

    Committee on Governance

    a. Motion to expand the tenured and tenure-track faculty to include those who may be designated as "teaching intensive' when appointed, and to adopt tenure criteria for these positions
    b. Motion to revise Appendix D in the Faculty Handbook
    c. Motion to add Guidance for Documenting and Assessing Activities Toward Tenure for Professors designated as teaching intensive
13. New Business
14. President's Report
15. Provost's Report
16. Adjournment

(will be presented for approval at the January 14th, 2021 meeting.)

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Faculty Meeting Materials, December 10, 2020

CONSENT AGENDA MOTIONS

CAO - Revise AE4733, AE4770, and AE4771
CAO - Add BB3530
CAO - Add BB3570
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CAO – Add Minor in Latin American and Caribbean Studies
CAO – Add HI1345
CAO – Add SP3533
CAO – Add SP3534

CGSR – Waiving option for the RBE 500 course requirement in the graduate catalog
CGSR – Redesign of the MBA program
CGSR – Modify policies related to Academic Standards for Graduate Students
CGSR - Revise MSMG graduate program

Date: December 10, 2020
To: WPI Faculty
From: Committee on Academic Operations (Prof. Mathisen, Chair)
Re: Motion to change the course descriptions for AE 4733, AE4770, and AE4771, as approved by the faculty of the Aerospace Engineering Department on 11/11/2020.

Motion: The Committee on Academic Operations recommends, and I move, that the course descriptions for AE 4733, AE 4771, and AE 4770 be modified as follows. Additions for each course are indicated with an underline and deletions with ~~overstrike~~. For each course, the proposed course description follows the marked-up version, and the rationale, impacts, and implementation dates are included. These revisions were approved by the AE Department on 11/11/2020.

AE 4733 – GUIDANCE, NAVIGATION, AND COMMUNICATIONS
Cat. I
This course covers methods and current ~~enabling~~ technologies in the analysis, synthesis, and practice of aerospace guidance, navigation, and communications systems. Topics covered include: attitude- and position kinematics, inertial navigation systems, global satellite navigation systems, communication architectures for satellite navigation, satellite link performance parameters and design considerations, tropospheric and ionospheric effects on radio-wave propagation, least squares estimation, and the Kalman filter.~~, and pursuit guidance.~~

AE 4733 – GUIDANCE, NAVIGATION, AND COMMUNICATIONS
Cat. I
This course covers methods and current technologies in the analysis, synthesis, and practice of aerospace guidance, navigation, and communications systems. Topics covered include: attitude- and position kinematics, inertial navigation systems, global satellite navigation systems, communication architectures for satellite navigation, satellite link performance parameters and design considerations, tropospheric and ionospheric effects on radio-wave propagation, least squares estimation, and the Kalman filter.

Rationale:
The proposed revision to the AE 4733 introduces additional Telecommunications topics. The expanded material in AE 4733 and the new material in AE 4771 (Motion 2) will address Telecommunications in these two courses required by the Astronautics track, in sufficient depth to satisfy the ABET Program criteria for aerospace engineering programs.

Impact on Distribution Requirements:
None.

Resource Needs:
No new resources are needed.

Implementation Date:
2020-21 academic year.

AE 4770. AIRCRAFT DESIGN. Cat. I
This course introduces students to design of aircraft systems. Students complete a conceptual design of an aircraft in a term-long project. Students are exposed to the aircraft design process, and must establish design specifications, develop and analyze alternative designs, and optimize their designs to meet mission requirements. Students work together in teams to apply material learned in the areas of aerodynamics, structures, ~~and~~ aerospace materials, propulsion, stability and control, and flight mechanics ~~and maneuvers~~ to the preliminary design of an aircraft. The project requirements are selected to reflect real-life aircraft mission requirements, and teams are required to design systems which incorporate appropriate engineering standards and multiple realistic constraints. The teams present their design in a final report and oral presentation.

Recommended background: aerodynamics (AE 3711 or equivalent), aerospace structures (AE 3712 or equivalent), air breathing propulsion (AE 4711 or equivalent), aircraft dynamics and control (AE 4723 or equivalent).

AE 4770. AIRCRAFT DESIGN. Cat. I
This course introduces students to design of aircraft systems. Students complete a conceptual design of an aircraft in a term-long project. Students are exposed to the aircraft design process, and must establish design specifications, develop and analyze alternative designs, and optimize their designs to meet mission requirements. Students work together in teams to apply material learned in the areas of aerodynamics, aerospace materials, structures, propulsion, flight mechanics, and stability and control, to the preliminary design of an aircraft. The project requirements are selected to reflect real-life aircraft mission requirements, and teams are required to design systems which incorporate appropriate engineering standards and multiple realistic constraints. The teams present their design in a final report and oral presentation.

Recommended background: aerodynamics (AE 3711 or equivalent), aerospace structures (AE 3712 or equivalent), air breathing propulsion (AE 4711 or equivalent), aircraft dynamics and control (AE 4723 or equivalent).

Rationale:
This motion addresses minor editorial revisions.

Impact on Distribution Requirements:
None.

Resource Needs:
No new resources are needed.

Implementation Date:
2020-21 academic year.

AE 4771. SPACECRAFT AND MISSION DESIGN.
Cat. I
This course introduces students to design of spacecraft and missions. Students are introduced to the process of designing a spacecraft and major subsystems to meet a specific set of objectives or needs. In addition, students will learn about different spacecraft subsystems and what factors drive their design..~~Particular emphasis is given to the propulsion, power, attitude control, telecommunications, structural, and structures subsystems. Students work together in teams to apply material learned in the areas of orbital mechanics, power, attitude determination and control, telecommunications, space structures, and propulsion to the preliminary design of a spacecraft and mission~~. Students complete a term-long spacecraft design project conducted by teams. The project addresses orbital mechanics, the space environment, attitude determination and control, telecommunications, space structures, and propulsion, along with other spacecraft subsystems. The project requirements are selected to reflect real-life missions, and teams are required to design systems which incorporate appropriate engineering standards and multiple realistic constraints. The teams present their design in a final report and oral presentation.

Recommended background: astronautics (AE 2713 or equivalent), space environments (AE/PH 2550), telecommunications (AE 4733),space structures (AE 3712 or equivalent), rocket propulsion (AE 4719 or equivalent), spacecraft dynamics and control (AE 4713 or equivalent).

AE 4771. SPACECRAFT AND MISSION DESIGN.
Cat. I
This course introduces students to design of spacecraft and missions. Students are introduced to the process of designing a spacecraft and major subsystems to meet a specific set of objectives or needs. In addition, students will learn about different spacecraft subsystems and what factors drive their design. Students complete a term-long spacecraft design project conducted by teams. The project addresses orbital mechanics, the space environment, attitude determination and control, telecommunications, space structures, and propulsion, along with other spacecraft subsystems. The project requirements are selected to reflect real-life missions, and teams are required to design systems which incorporate appropriate engineering standards and multiple realistic constraints. The teams present their design in a final report and oral presentation.

Recommended background: astronautics (AE 2713 or equivalent), space environments (AE/PH 2550), spacecraft dynamics and control (AE 4713 or equivalent), telecommunications (AE 4733),space structures (AE 3712 or equivalent), rocket propulsion (AE 4719 or equivalent),

Rationale:
The proposed revisions to AE 4771 introduce Telecommunication topics in the coverage and the project. The new material in AE 4771 and the expanded material in AE 4733 (Motion 1) will address Telecommunications in these two courses required by the Astronautics track, in sufficient depth to satisfy the ABET Program criteria for aerospace engineering programs. The motion adds the space environments in order for the project to address all curricular topics required by Astronautics.

Impact on Distribution Requirements:
None.

Resource Needs:

No new resources are needed.

Implementation Date:
2020-21 academic year.

Date: December 10, 2020
To: WPI Faculty
From: Committee on Academic Operations (Prof. Mathisen, Chair)
Re: Motion to add BB 3530 IMMUNOTHERAPIES: THE NEXT GENERATION OF PHARMACEUTICALS approved by the Biology & Biotechnology faculty on November 5,2020

Motion: The Committee on Academic Operation recommends, and I move, that BB 3530 IMMUNOTHERAPIES: THE NEXT GENERATION OF PHARMACEUTICALS as described below, be added.

Course Description:
BB 3530. IMMUNOTHERAPIES: THE NEXT GENERATION OF PHARMACEUTICALS
Cat 1
While the production of monoclonal antibodies has been around since the 1970s, their clinical use as human therapeutics represents an increasingly popular and promising application. Beginning with a hybridoma cell line and using a discovery based approach, students in this course will explore the processes involved in the production and purification of monoclonal antibodies. Using cells in culture to produce the antibody, students will explore the efficacy and cost of a purification scheme involving separation techniques such as ion exchange and affinity chromatography to produce a purified product. Purification will be assessed using typical analytical techniques such as spectroscopy, electrophoresis and immunological based methods. Recommended background: a working knowledge of laboratory skills in enzyme and protein purification (BB 2902 or equivalent) and concepts in cell biology and biochemistry (BB2550 and CH4110 or equivalent). Some knowledge of immunology may be beneficial.

Anticipated Instructor: JoAnn Whitefleet-Smith

Rationale: This course is part of the department's laboratory curriculum. We are moving to more authentic research and discovery based labs and away from prescribed protocol driven sessions. Students in this course will be given options to explore using a discovery based method to arrive at the understanding and outcomes described in the course learning outcomes.
Learning outcomes: Students in this course will be prepared to

- demonstrate skills in mammalian cell culture, separation techniques, and protein purification and analytic techniques
- list and explain the advantages, disadvantages and limitations of the separation and analytical techniques
- provide examples of the use of monoclonal antibodies (the new biologics) in medical practice.
- explain the concept of monoclonal and polyclonal antibodies including the advantages and disadvantages related to their therapeutic use.
- describe a culture and purification scheme relevant to the biologic process and explain the rationale for each step in the process
- discuss the differences and challenges in moving from laboratory to pilot scale production.

If previously offered as an experimental course, make sure to include a summary of the following:

Student Feedback:

From course evaluations and Qualtrics survey:

	Ave Q1	Ave Q2	Ave Q9	Ave response: relative to other college course amount of assigned work	Ave response: in a 7-day week time spent OUTSIDE of formally scheduled class time related to this course
2019	4.3	4.8	4.9	4	1-5 hrs = 3; 6-10 hours= 4; 11-15 hrs=1
2020	4.7	4.6	4.7	4	1-5 hrs = 1; 6-10 hours= 2; 11-15 hrs=3; 16-20 = 1

#	Field	No or very small gain	Small gain	Moderate gain	Large gain	Very large gain	applicable / Prefer not to answer	Total
1	Generating valid hypotheses	0.00% 0	0.00% 0	37.50% 3	12.50% 1	37.50% 3	12.50% 1	8
2	Designing valid experiments	0.00% 0	0.00% 0	0.00% 0	37.50% 3	50.00% 4	12.50% 1	8
3	Appropriately displaying and analyzing data	0.00% 0	0.00% 0	25.00% 2	25.00% 2	50.00% 4	0.00% 0	8
4	Interpreting results to reach valid conclusions.	0.00% 0	0.00% 0	12.50% 1	25.00% 2	62.50% 5	0.00% 0	8
5	Placing my results in the appropriate broader scientific or societal context	0.00% 0	25.00% 2	0.00% 0	25.00% 2	37.50% 3	12.50% 1	8
6	Critically evaluating the relevant scientific literature	0.00% 0	25.00% 2	25.00% 2	12.50% 1	25.00% 2	12.50% 1	8
7	Collaborating with other researchers (including students and instructors)	0.00% 0	0.00% 0	25.00% 2	0.00% 0	75.00% 6	0.00% 0	8
8	Understanding and applying accepted standards of intellectual honesty in research	0.00% 0	0.00% 0	25.00% 2	12.50% 1	50.00% 4	12.50% 1	8

Using a Likert scale of 1-5 where 1 was little or no gain and 5 was a very large gain, students reported gains in

- Understanding how scientific knowledge is constructed: Mean = 3.0
- Learning laboratory techniques: Mean = 4.1
- Self confidence as a researcher: Mean = 3.9

Asked whether they would choose a research based or more traditional laboratory course in the future, 5/8 chose research based, 2 had no preference and 1 would choose a course with a traditional lab format.

Instructor feedback and reflections

On the whole, students met the learning objectives for this course in both experimental offerings. They had a broad range of experience even though they were given a fair amount of latitude to develop their own experimental protocols, and most enthusiastically embraced this independence. It is more difficult to teach this type of authentic research lab, but I find it more stimulating and fun.
My assessment of what could and should be improved matched student comments and will be incorporated into to future offerings.

Course populations:
2019: 8
2020: 9
The course limit for both experimental offerings was set at 10

Implementation Date: Implementation date for this action is the 2021-2022 Academic year.

Resource Needs:
There is no change in the resources needed from those available for the experimental offerings. (see original proposal)

Impact on Distribution Requirements and Other Courses: As proposed, this course would fulfill a laboratory distribution requirement for BBT or biochemistry majors. Any student with a working knowledge of laboratory skills in enzyme and protein purification (BB 2902 or equivalent) and concepts in cell biology and biochemistry (BB2550 and CH4110 or equivalent) (notably CBC and BCB majors) would have access to and be well prepared to take this course. No change to the wording of distribution requirements is needed, as this falls under the category of laboratory courses.

Original experimental course proposal:
To: Chair, Committee on Academic Operations
From: Biology & Biotechnology Department
Re: Motion to add BB 353X, *Immunotherapies: the next generation of pharmaceuticals*, approved by the Biology & Biotechnology Department Faculty on 10/14/2018
Date: 10/15/2018

The Department of Biology & Biotechnology requests the approval of the following experimental course 353X, *Immunotherapies: the next generation of pharmaceuticals,* in Academic Years 2020 and 2021 during A term.

Contact: Prof. Jill Rulfs

Preferred term: A
Expected enrollment: 12
Course type: Laboratory
Intended audience: Primary audience BBT and CBC majors. Also of potential interest to CHE, BCB and BME students.

Anticipated Instructor: JoAnn Whitefleet-Smith

Course/Catalog Description:
BB 353X. IMMUNOTHERAPIES: THE NEXT GENERATION OF PHARMACEUTICALS
Cat I (1/3 unit)
While the production of monoclonal antibodies has been around since the 1970s, their clinical use as human therapeutics represents an increasingly popular and promising application.Beginning with a hybridoma cell line and using a discovery based approach, students in this course will explore the processes involved in the production and purification of monoclonal antibodies. Using cells in culture to produce the antibody, students will explore the efficacy and cost of a purification scheme involving separation techniques such as ion exchange and affinity chromatography to produce a purified product. Purification will be assessed using typical analytical techniques such as spectroscopy, electrophoresis and immunological based methods.
Recommended background: a working knowledge of laboratory skills in enzyme and protein purification (BB 2902) and concepts in cell biology and biochemistry (BB2950 and CH4110 or equivalent).Some knowledge of immunology may be beneficial.

Rationale:
This course is the next step in the department's laboratory curriculum design, moving to more authentic research based labs and away from prescribed protocol driven sessions. Students will be given options to explore using a discovery based method to arrive at the understanding and outcomes described in the course learning outcomes.
Learning outcomes: Students in this course will be prepared to

- demonstrate skills in mammalian cell culture, separation techniques, and protein purification and analytic techniques
- list and explain the advantages, disadvantages and limitations of the separation and analytical techniques
- provide examples of the use of monoclonal antibodies (the new biologics) in medical practice.
- explain the concept of monoclonal and polyclonal antibodies including the advantages and disadvantages related to their therapeutic use.
- describe a culture and purification scheme relevant to the biologic process and explain the rationale for each step in the process
- discuss the differences and challenges in moving from laboratory to pilot scale production.

Resource Needs:
Please summarize basic resources needed to deliver this course, including the following:

- The faculty member responsible for design and delivery of this course is JoAnn Whitefleet-Smith. This request is coupled with moving two courses Dr. Whitefleet-Smith currently teaches to Cat II status, to free up her time and the laboratory space to accommodate this new offering.
- The course will be taught in laboratory facilities in Goddard Hall the use of which are currently scheduled by the BBT Department
- Students will be referred to a Research and Instruction librarian for help with required literature searches.

Assessment:
Assessment will be done using the current student course evaluation system. Instructor provided questions will query student attitudes related to course design and efficacy. Learning outcomes will be assessed by in-lab quizzes, pre-lab assignments designed to encourage background reading and laboratory preparation, laboratory notebook entries and post-lab reporting.

Date: December 10, 2020
To: WPI Faculty
From: Committee on Academic Operations (Prof. Mathisen, Chair)
Re: Motion to add BB 3570: CELL CULTURE MODELS FOR TISSUE REGENERATION approved by the faculty of Biology & Biotechnology on November 5, 2020

Motion: The Committee on Academic Operation recommends, and I move, that BB 3570: CELL CULTURE MODELS FOR TISSUE REGENERATION as described below, be added.

Course/Catalog Description:
BB 3570, **CELL CULTURE MODELS FOR TISSUE REGENERATION**
Cat I (1/3 unit)
This course is an intensive hands-on laboratory that explores mammalian cells as building blocks of complex tissues *in vitro*. In addition to learning standard cell culture skills, students will have the opportunity to examine cell survival, proliferation, differentiation, and function under different culture conditions. The course culminates with design and development of a cell-based system for an application in regenerative medicine (e.g., wound healing and fibrosis). Students will synthesize and present their work in the form of a research manuscript.

Recommended background: a working knowledge of the principles of cell biology (BB 2550 or equivalent) and molecular biology and/or genetics (BB 2920 or 2950 or equivalent) as well as foundational lab experience such as that offered in the BB 2900 lab sequence.

Rationale:
This course is part of the BBT Department's initiative to move our laboratory teaching to an authentic research paradigm. The rationale for this change lies in the national call to transform undergraduate science teaching. Among the recommendations included in the President's Council of Advisors on Science and Technology (PCAST) report, *Engage to Excel*, and in the AAAS/NSF report, *Vision and Change in Undergraduate Biology Education*, is replacing standard laboratory courses with discovery-based research courses. This laboratory course will provide the opportunity for students to utilize contemporary cell biology and cell culture approaches to address authentic research problems posed by BBT faculty. As an upper level 1/3 unit laboratory, this course will allow for and be reflective of the time and effort required for a more comprehensive exploration of the scientific research method by the students.

Learning outcomes: Upon completion of this course, students will be able to

- demonstrate mastery of the procedural skills required to conduct cell culture-based experiments, including sterile technique, cell staining, and microscopy.
- describe the roles of cell and matrix interactions in cell/tissue survival and functionality.
- design appropriate experiments using contemporary approaches and techniques in cell biology.
- articulate a testable hypothesis and properly collect, record, and analyze experimental data to assess its validity.
- present findings clearly in written format (i.e., similar to a research journal article) and verbally while adhering to the standards, style, and intellectual honesty expected of life scientists.
- function effectively, safely, and collaboratively as part of a team of scientists.

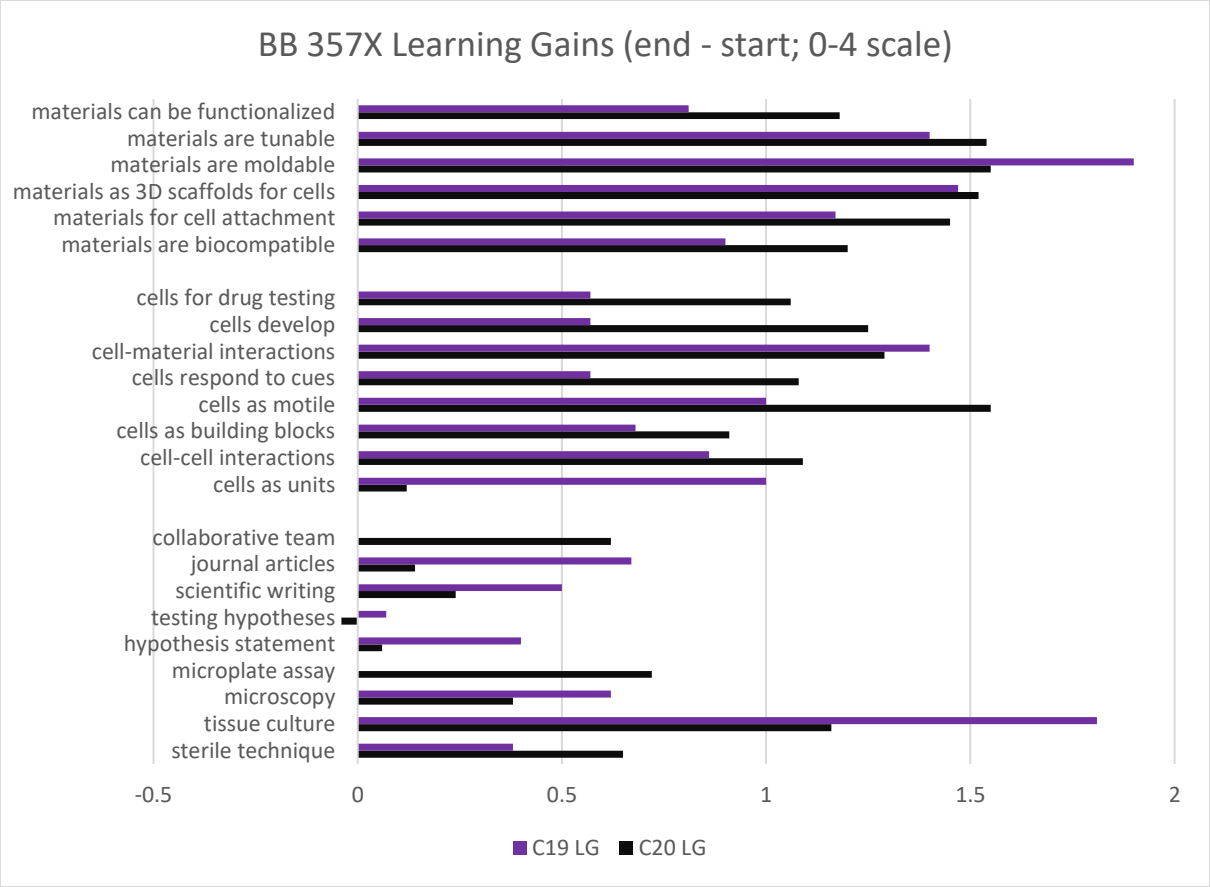
Anticipated Instructor: Lou Roberts

Student feedback:

WPI course evaluation data:

Question		C19	C20
Q1		4.0	4.5
Q2		4.6	4.1
Q9		4.6	5.0
Q11		2.6	3.4
Q19	1-5 hrs/wk:	80% of responses	50% of responses
	6-10 hrs/wk:	20% of responses	37% of responses
	11-15 hrs/wk:	0% of responses	13% of responses

Additional student feedback was collected via a Skills and Concepts Inventory administered on the first and last days of the course (survey appended; learning gains summary below). Standard CURE and LCAS assessments were also utilized. These indicate students believed their results to be novel and of broad interest, and that collaboration with peers is a valued component of this course.



Skills and Concepts Inventory Results, C19 and C20. A score of zero indicates no gain in learning for a particular skills/concept. Students indicated notable learning gains in the techniques, greater learning gains in the concepts of the utility of cells, and the highest learning gains on concepts of materials and their interactions with cells.

Instructor feedback and reflections:

BB357X ran for the first time in C term, 2019, and was offered again in C2020. This lab was designed and run as an authentic research and writing-intensive course. Students successfully met all stated learning outcomes by the conclusion of the course. Most impressively the students were able to come up with original designs, and work through the process to develop, build, and test their models. The students also exhibited maturation in the scientific technical writing process, transforming from verbose and tentative writers to succinct and confident authors.

The initial offering was unique in two respects- only six students were enrolled, and Prof. Rob Traver participated along with Prof. Roberts in the writing process. The second year was filled to near capacity with 14 students (the C2021 offering has 15 students rostered), and Prof. Roberts was solely responsible for the writing curriculum. In the first offering, Week 1 was dedicated to students forming groups, and learning aseptic and animal cell culture techniques. Students were also given three small writing assignments to teach succinctness in technical writing. Weeks 2-4 focused on making beads and gels and figuring out how to seed cells into these materials. Students began to work on creating a tissue model using the cell lines and materials available to them, and by the end of Week 6 had developed and written a testable

design plan; these included a skin model for UV irradiation, and a deep wound model for diabetic ulcers. Students had one opportunity to put their designs to work and determine the fate of the cells. The writing initiatives were directed towards first crafting and then converting the design plans into journal articles. Additionally, a Biology PhD student completed her TA practicum with a side project on integrated culture of plant and animal cells. All objectives were met, though the ability to optimize designs and refine their journal articles was not possible before the end of the term.

While pleased with the way the initial offered went, I set out with two main foci for C20- to make sure the student experience and research undertaken would be not adversely affected by the increase in scale from 6 to 15 students, and to initiate the design and testing process earlier, so students could optimize their rebuilds and receive iterative feedback on their final journal article. With respect to scale, students worked as a group of three rather than in pairs, and cell culture hood space (our main resource limitation) was scheduled for each team. I also restructured some of the initial writing assignments and lab work so the students could start their design plan in Week 4, commence testing in Week 5, and start redesigning for a second build and trial while their first model was still being evaluated. This change to the schedule had the intended effects with regards to experimentation and writing- each group emerged with two cycles of design-build-test and the revisions they had time to make to their journal articles notably increased the quality of the final product. For C21 I intend to adhere to a similar schedule, cognizant of the need to address COVID-related alterations (which have already been deployed in other biology labs).

In summary, I set to develop a new writing-intensive laboratory course that would allow students the authentic research experience of researching, designing, building, testing, and writing up the results of their cell culture models. Students took advantage of the latitude we offered with respect to cell lines, media, materials, topologies, and equipment available, and conceived and created truly unique designs with a purpose. The skin and disease models the students constructed were creative, clever, and logical. Students also were able to dissect peer-reviewed articles written by undergraduates in addition to lauded experts in the field. This allowed them to construct their own articles in such a manner that adheres to the standards and expectation of scientific writing. The writing, review, and publishing process felt much more accessible to the students as they experienced it in microcosm in this course. I feel this course fully satisfies the authenticity we sought in both research and technical writing.

Course populations:
2019: 6 with an enrollment limit of 10
2020: 14 with an enrollment limit of 15

Implementation Date: Implementation date for this action is the 2021-2022 Academic year.

Resource Needs:
There is no change in the resources needed from those available for the experimental offerings. (see original proposal)

Impact on Distribution Requirements and Other Courses: As proposed, this course would fulfill a laboratory distribution requirement for BBT or biochemistry majors. Any student with a working knowledge of the principles of molecular and cell biology and/or genetics (notably CBC and BCB majors) would have access to this course. No change to the wording of distribution requirements is needed, as this falls under the category of laboratory courses.

Original experimental course proposal:

To: Chair, Committee on Academic Operations
From: Biology & Biotechnology
Re: Motion to add BB 357X approved by the BBT Dept. Faculty on March 15, 2018.
Date: 3/15/18

The Department of Biology & Biotechnology requests the approval of the following experimental course BB 357X, *Cell Culture Models for Tissue Regeneration* in Academic Years 2018/19 and 2019/20 during C term.

Contact: Jill Rulfs
Preferred term: C
Expected enrollment: 16 students
Course type: laboratory
Intended audience: As proposed, this course would fulfill a laboratory distribution requirement for BBT or CBC majors. If the course becomes permanent, any student with a working knowledge of the principles of cell and molecular biology and/or genetics would have access to this course.

Anticipated Instructor: Lou Roberts

Course/Catalog Description:
BB 357X, **CELL CULTURE MODELS FOR TISSUE REGENERATION**
Cat I (1/3 unit)
This course is an intensive hands-on laboratory that explores mammalian cells as building blocks of complex tissues *in vitro*. In addition to learning standard cell culture skills, students will have the opportunity to examine cell survival, proliferation, differentiation and function under different culture conditions. The course culminates with design and development of a cell-based system for an application in regenerative medicine (e.g., wound healing and fibrosis). Students will synthesize and present their work in the form of a research manuscript.

Recommended background: a working knowledge of the principles of cell biology (BB 2550 or equivalent) and molecular biology and/or genetics (BB 2920 or 2950 or equivalent) as well as foundational lab experience such as that offered in the BB 2900 lab sequence.

Rationale:
This course is the latest offering in the BBT Department's initiative to move our laboratory teaching to an authentic research paradigm. The rationale for this change lies in the national call to transform undergraduate science teaching. Among the recommendations included in the

President's Council of Advisors on Science and Technology (PCAST) report, *Engage to Excel*, and in the AAAS/NSF report, *Vision and Change in Undergraduate Biology Education*, is replacing standard laboratory courses with discovery-based research courses. This laboratory course will provide the opportunity for students to utilize contemporary cell biology and cell culture approaches to address authentic research problems posed by BBT faculty. As an upper level 1/3 unit laboratories (as opposed to all current 3500 BBT lab courses which are worth1/6 unit of credit), this course will allow for and be more reflective of the time and effort required for a more comprehensive exploration of the scientific research method by the students.

Learning outcomes: Upon completion of this course, students will be able to

1. demonstrate mastery of the procedural skills required to conduct cell culture-based experiments, including sterile technique, cell staining, and microscopy.
2. describe the roles of cell and matrix interactions in cell/tissue survival and functionality.
3. design appropriate experiments using contemporary approaches and techniques in cell biology.
4. articulate a testable hypothesis and properly collect, record, and analyze experimental data to assess its validity
5. present findings clearly in written format (i.e., similar to a research journal article) and verbally while adhering to the standards, style, and intellectual honesty expected of life scientists.
6. function effectively, safely, and collaboratively as part of a team of scientists.

Resource Needs:

- This will become part of Professor Roberts' teaching responsibilities. Other teaching responsibilities in our curriculum have been redistributed to allow him to teach this course. We have a cohort of faculty whose primary responsibilities are in laboratory teaching, any one of whom could teach this course at any time if situations arose that made it necessary.
- This will be taught in existing space in Goddard Hall (GH 205 and 212) that primarily designed and used for teaching biology laboratory and is currently unscheduled during the time in which we propose to teach this course.
- There are no anticipated needs for other resources

Assessment:
The course will be assessed by the distribution of WPI's official student course evaluations, as well as through LCAS and CURE surveys. After each of the experimental offerings, all assessment data, including instructor reflections and observations, will be shared with the departmental undergraduate curriculum working group. If the decision is made at the department level to make this a permanent course offering, all of our assessment data will be included in our formal proposal to CAO. We will be sure to specifically report to CAO the data from the current questions 1, 2, 19 and 26b. The instructor will use available mid-term course feedback for formative assessment purposes.

Anticipated impact: As proposed, this course would fulfill a laboratory distribution requirement for BBT or biochemistry majors. Any student with a working knowledge of the principles of cell and molecular biology and/or genetics (notably CBC and BCB majors) would have access to this course.
**Proposed course numbers should never have been used. (Contact the Administrator of Academic programs to confirm the number has not been used previously).*

Date: December 10, 2020
To: WPI Faculty
From: Committee on Academic Operations (Prof. Mathisen, Chair)
Re: Addition of **CE 4020, Resilient Infrastructure for a Changing Climate,** as approved by the Civil and Environmental Engineering Department on 09/29/20

Motion: The Committee on Academic Operation recommends and I move, that CE 4020, Resilient Infrastructure for a Changing Climate, as described below, be added to the catalog.

Course/Catalog Description: CE 4020, Resilient infrastructure for a changing climate
Cat. II
This course is intended to provide students with understanding, knowledge, skills, and tools to evaluate the risk to, and resilience of, infrastructure components to climate change-related and extreme weather events, and to conduct further study and research on this subject. Methods to consider impact of climate change and extreme weather events on the infrastructure, understand different Intergovernmental Panel on Climate Change (IPCC) scenarios, utilize downscaled data for design of infrastructure, estimation of vulnerability, criticality, consequence, risk and resiliency, in both qualitative and quantitative ways. Available adaptation frameworks and tools/software for increasing resiliency will be presented.

Recommended background: Basic knowledge of applied statistics (MA 2611 or similar), probability for applications (MA 2621 or similar), statics (CE 2000 or similar), structural engineering (CE 3010 or similar), and materials of construction (CE 3026 or similar

Anticipated Instructor: Rajib B. Mallick, Civil and Environmental Engineering

Rationale: There is a need for a course that teaches students to recognize, understand and consider the impacts of climate change and extreme weather events in planning, design and construction of infrastructure. This need is even more critical in the light of the fact that civil engineering students are not generally exposed to climate related courses in their curriculum. This course will also provide opportunities for students to cultivate their entrepreneurship skills for developing innovative solutions to this global challenge

Two offerings of this course (in Experimental mode) have been made in the recent past. We anticipate a growing interest on this topic and hence an increased number of students in the future. Hence, a permanent course is needed.

An ever-increasing global population is driving the need to design and build infrastructure systems in many regions of the world that are generally considered to be vulnerable to natural hazards. This need, coupled with climate change related increase in extreme weather events, such as flooding, is putting millions of people around the world at a higher risk of disasters. Projections from the IPCC are that the frequencies of heavy precipitation, as well as rainfall from tropical cyclones, are likely to continue to increase in this century. Evidence from three recent hurricanes in the US, Katrina, Irene and Sandy, support the research findings very strongly; the resulting floods affect the coastal communities and millions of citizens. Extreme heat can exceed

the design limits of bridges, aircraft, runways, pavement and other infrastructure, and place greater demands on HVAC systems and electricity infrastructure (such as power lines) at the very times that power transmission must be shut down to prevent power-line-sparked fires.

Performance and design life of infrastructure components such as roads and bridges are dictated primarily by climate factors such as temperature, rainfall and sea level rise. Currently, Civil engineering structures are designed with a consideration of past climate data – under the assumption that the climate does not change over the time and that variability is within a predictable range. Research has proven that this is no longer true. Infrastructure designed for an assumed set of conditions is becoming increasingly vulnerable to changes in sea level, extreme flood and wave events, and temperature extremes, particularly in coastal regions and along rivers where most of the world population resides. There is a critical need for adaptation of the planning, design and construction process that will provide the required resilience for critical structures against extreme weather events which are likely to increase as a result of climate change. In the last five years a significant amount of literature has been generated in this area as a result of academic/research and federal, state and private agency activities.

The purposes of this proposed course are to provide participants with:

1. An understanding of the impacts of extreme weather-related phenomena on various types of infrastructure
2. An understanding of climate change data, current impacts, and various projections
3. An understanding of the linkages between climate change effects and performance/durability, economics and safety of infrastructure components
4. Ability to utilize available climate change data in the planning and design of infrastructure components
5. Ability to evaluate the risk (hazard, vulnerability, risk) of extreme events and climate change on the infrastructure
6. Ability to evaluate the resiliency of infrastructure to extreme weather and climate change related phenomena such as flooding
7. Ability to develop suitable recommendations for improving the resiliency of infrastructure

The learning outcomes are as follows. At the end of the course the students will be able to:

1. Identify the types of climate effects (and their uncertainty) that will likely affect infrastructure;
2. Assess the form and extent of vulnerability;
3. Evaluate the probability and magnitude of risk to infrastructure;
4. Identify and prioritize the infrastructure assets that might be vulnerable (including related uncertainties);
5. Evaluate the different adaptation strategies, and then make an informed decision regarding adaptation.

Implementation Date: We expect that this course will be offered in 2021-2022 academic year.

Resource Needs:

This will be part of Rajib Mallick's normal teaching load. Classroom space for all of the students, which may grow over time – in the near term, this would possibly be an online course in Fall 2021 if COVID remains a problem;
Laboratory: N/A
Library: Journal Access to original articles
IT: N/A

Impact on Distribution Requirements and Other Courses:

This course is expected to serve as an in-depth course for Structural, Geotechnical and Transportation area, and we do not anticipate any impacts on the distribution requirements for CEE or other departments.

There are some gaps in WPI course offerings that need to be filled in a way that recognizes our changing world. First, because WPI lacks earth science departments (e.g., geoscience, ocean and atmospheric science, earth system science), there is a need for courses that expose students to climate and earth science fundamentals in order to put a range of future engineering needs into perspective. This is among those courses – but not the only one. The Civil and Environmental Engineering department hosts the institutions only geoscience course, GE 2341, and department course offerings are in the process of being expanded to Earth System Science. There are new degree programs under consideration, including CEE's collaboration with the Global School in the Community Climate Action MS program, and an MS program in Global Sustainable Infrastructure that has been proposed at the department level. The CEE department is also involved, with others, in the creation of a Climate Minor. This proposed course dovetails with all of these programs and prepares the way for them, providing elective curriculum content. This course also serves a rapidly growing interest among students in Civil and Environmental Engineering in using their degrees and expertise to confront climate change and its effects upon our infrastructure.

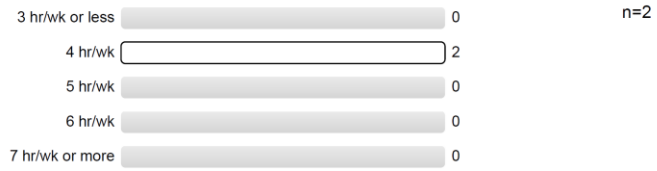
APPENDIX

Experimental Course, CE 402X, offered in 2017 and 2018

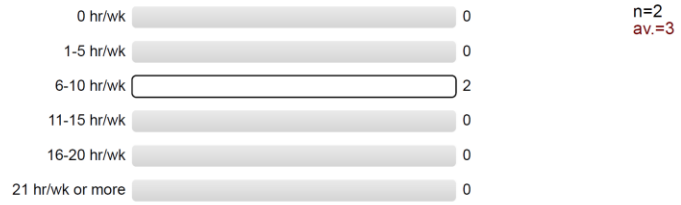
	2017 (n = 2)	2018 (n = 3)
My overall rating of this course	5	4
My overall rating of the instructor	5	4.3
The educational value of the assigned work	5	3.7
The amount I learned from the course	5	4.3
The intellectual challenge by this course	5	4.3

CE 402 X, 2017

26A. On average, how many hours of the formally scheduled hours for lecture, conference, and labs did you ATTEND each week?

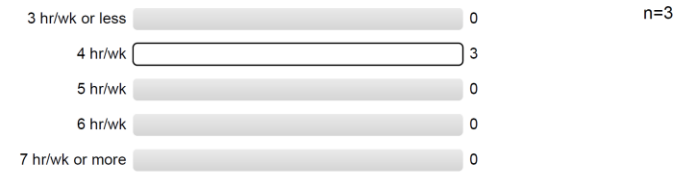


26B. On average, what were the total hours spent in each 7-day week OUTSIDE of formally scheduled class time in work related to this course (including studying, reading, writing, homework, rehearsal, etc.)?

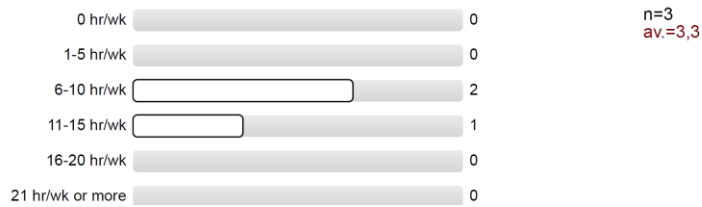


CE 402 X, 2018

26A. On average, how many hours of the formally scheduled hours for lecture, conference, and labs did you ATTEND each week?



26B. On average, what were the total hours spent in each 7-day week OUTSIDE of formally scheduled class time in work related to this course (including studying, reading, writing, homework, rehearsal, etc.)?



Also include original experimental course proposal if applicable.

**Proposed course numbers should never have been used. (Contact the Administrator of Academic programs to confirm the number has not been used previously).*

CAO approved motion to add an experimental, course CE 402X

Clark, William M.
You replied on 11/23/2015 5:33 PM.
Sent: Monday, November 23, 2015 5:04 PM
To: Kornik, Charles J.
Cc: Lindeman, Robert W.; El-Korchi, Tahar; Mallick, Rajib B.
Attachments: CE402X-Proposed exp cours~1.docx (30 KB)
Dear Chuck,
Attached please find a CAO approved motion to add a new experimental course, CE 402X. Resilient Infrastructure for a Changing Climate.
Thank you for your kind attention to this matter,
Don Clark, CAO liaison

Original Experimental Course Proposal

To: Chair, Committee on Academic Operations
From: Tahar El Korchi, Department Head, Civil and Environmental Engineering
Re: Motion to add CE 402X. Resilient Infrastructure for a Changing Climate, approved by Civil and Environmental Engineering Faculty on 10.27.2015
Date: _10_/_27_/_2015

The Department of Civil and Environmental Engineering requests the approval of the following experimental course CE 402X - Resilient Infrastructure for a Changing Climate in Academic Years 2016 and 2017 during C terms.

Contact: Prof. Tahar El-Korchi/Rajib B Mallick
Preferred term: C
Expected enrollment: 15
Course type: Upper level undergraduate
Intended audience: If the course becomes permanent: potentially all CEE, EVE and AREN students

Anticipated Instructor: Prof. Rajib B. Mallick

Course/Catalog Description: CE 402X, Resilient infrastructure for a changing climate, Cat.I This course is intended to provide students with understanding, knowledge, skills and tools to evaluate the risk and resilience of infrastructure components to climate change related and extreme weather events, and to conduct further studies and research on this subject. Methods to consider impact of climate change and extreme weather events on the infrastructure, understand

different Intergovernmental Panel on Climate Change (IPCC) scenarios, utilize downscaled data for design of infrastructure, estimation of vulnerability, criticality, consequence, risk and resiliency, in both qualitative and quantitative way, and available adaptation frameworks and tools/software for increasing resiliency will be presented.

Recommended background: basic knowledge of applied statistics (MA 2611 or equivalent), probability for applications (MA 2621 or equivalent), statics (CE 2000 or equivalent), structural engineering (CE 3010 or equivalent), and materials of construction (CE 3026 or equivalent)

Rationale:
An ever increasing global population is driving the need to construct infrastructure systems in many regions of the world that are generally considered to be vulnerable to natural hazards. This need, coupled with climate change related increase in extreme weather events, such as flooding, is putting millions of people around the world at a higher risk of disasters. Projections from the IPCC are that the frequencies of heavy precipitation, as well as rainfall from tropical cyclones, are likely to continue to increase in this century. Evidence from three recent hurricanes, Katrina, Irene and Sandy in the US support the research findings very strongly; the resulting floods would affect much of the coasts and millions of citizens. As projected by the IPCC, rising sea levels is virtually certain (>99% probability of occurrence) to continue, and increases in intense precipitate events are highly likely (>90% probability of occurrence) to become more frequent in widespread areas of the United States. As a consequence, along coastal areas and low-lying river areas flooding will be expected to occur more frequently, such as the Midwest flooding along the Mississippi river.
Performance and design life of infrastructure components such as roads and bridges are dictated primarily by climate factors such as temperature, rainfall and sea level rise.

Currently, Civil engineering structures are designed with a consideration of stationarity of climate data - that is the climate does no change over the time and the variability is within a specific range. Research has proven conclusively that this approach is erroneous and needs to be corrected and that the infrastructure is becoming increasingly vulnerable to changes in sea level, extreme flood and wave events, and temperature extremes, particularly in coastal regions and along rivers where most of the world population reside. There is a critical need for adaptation of the planning, design and construction process that will provide the required resilience for critical structures against extreme weather events which are likely to increase as a result of climate change. In the last five years a significant amount of literature has been generated in this area as a result of academic/research and federal, state and private agency activities.

Climate change related risks and resiliency topics have continued to be featured and highlighted in every major forum all over the world. On November 1st, 2013 President Obama signed an Executive Order on establishing a Task Force on Climate Preparedness and Resilience to advise the Administration on how the Federal Government can respond to the needs of communities nationwide that are dealing with the impacts of climate change. The first international conference on resilience of transportation infrastructure to climate change and extreme weather events was held at the National Academy of Sciences in mid-September, 2015 in Washington DC. The NSF funded Infrastructure Climate Network (ICNET) was started three years ago to bring civil engineers and climate scientists together on this issue, and an extensive knowledge base has been

generated from this effort. The US EPA, the US Department of Transportation, National Oceanic and Atmospheric Administration (NOAA) and the US Army COE has developed toolkits and frameworks for the evaluation of risk and resiliency of infrastructure. Extensive work has been also going on in other countries, such as Netherlands, Germany and France. Finally, a series of climate change and resilience related research solicitations are being developed by NSF for the near future.

There is a need for a course that teaches students to recognize, understand and consider the impacts of climate change and extreme weather event in planning, design and construction of the infrastructure and the need for the development of suitable adaptation methods. This need is even more critical in the light of the fact that civil engineering students are not generally exposed to climate related courses in their curriculum. Such a course will also provide opportunities for students to cultivate their entrepreneurship skills for developing innovative solutions to this worldwide challenge.

The purposes of this course are to provide participants with:

8. An understanding of the impacts of extreme weather related phenomena on the infrastructure
9. An understanding of climate change data, and various projections
10. An understanding of the linkages between climate change effects and performance/durability, economics and safety of infrastructure components
11. Ability to utilize available climate change data in the planning and design of infrastructure components
12. Ability to evaluate the risk (hazard, vulnerability, risk) of extreme events and climate change on the infrastructure
13. Ability to evaluate the resiliency of infrastructure to extreme weather and climate change related phenomena such as flooding
14. Ability to develop suitable recommendations for improving the resiliency of infrastructure

The learning outcomes are as follows. At the end of the course the students will be able to:

6. Identify the types of climate effects (and their uncertainty) that will likely affect the infrastructure;
7. Assess the form and level of vulnerability;
8. Evaluate the magnitude and likelihood of the risk;
9. Identify and prioritize the infrastructure assets that might be vulnerable (including related uncertainties);
10. Evaluate the different adaptation strategies, and then make an informed decision regarding adaptation

Brief outline of the course
The proposed course will consist of the following topics: 1. Overview of extreme events and climate change related events – warmer winters, more frequent freezing-thawing, rising sea water level, combined with storm surges, flooding; more frequent and intense storms, higher precipitation; rise in average surface temperature; prolonged droughts; 2. Reasons of climate

change; 3. IPCC climate data and projections; 4. Evaluating risks (hazard, vulnerability and consequence); 5. Resiliency; 6. Systems approach in evaluation of resiliency; 7. Different approaches (framework, tools/software) for building a resilient infrastructure; 8. Case studies

Resource Needs:

- Information on the instructor: Professor Rajib Mallick has been attending workshops and webinars on this topic for the last three years as part of the steering committee of the ICNET, has been conducting climate change and extreme weather related research for the ICNET, the Federal Highway Administration and Massport, and has published papers and made presentations on this topic. Case studies from these research work will be utilized in this course.
- Classroom: No special classroom is required
- Laboratory: No laboratory is required
- Library resources: Adequate documentation is available online
- Information Technology: All required software are in the public domain
  This course will be taught as part of the normal teaching load of an existing faculty member
  Assessment will be conducted with:

1. Student evaluation, which will include the following (1, 2, 9 and 26B):
   - My overall rating of the quality of this course is
   - My overall rating of the instructor's teaching is
   - The amount I learned from the course was On average, what were the total hours spent in each 7-day week OUTSIDE of formally scheduled class time in work related to this course (including studying, reading, writing, homework, rehearsal, etc.)?
2. Instructor feedback and reflection
3. Specific survey for this course

Optional: *Describe the anticipated impact adding this course will have on the distribution requirements in the department, as well as other departments or programs*

Date: December 10, 2020
To: WPI Faculty
From: Committee on Academic Operations (Prof. Mathisen, Chair)
Re: Motion to introduce a Minor in Latin American and Caribbean Studies, approved by and the Humanities and Arts Department on 11/6/2020.

Motion: The Committee on Academic Operations recommends and I move, that a Minor in Latin American and Caribbean Studies be introduced into the WPI curriculum.

A. Rationale

This proposal is for the creation of a Minor in Latin American and Caribbean Studies based in and endorsed by the Department of Humanities and Arts.

The purpose of this curricular innovation is to bring together WPI's efforts to address critical issues affecting Latin American and the Caribbean in connection with the wider world. It aims to better educate our students and provide in-depth expertise on this region's culture, history, and current challenges, and their interconnection with processes across world regions, especially the United States. Long-standing relationships between the U.S. and Latin America have expanded in recent decades. Migration, cultural and technological advances, social media, and environmental sustainability are reconfiguring traditional socio-political and economic relations in the Western Hemisphere. As a result, interactions between the U.S. and Latin America and the Caribbean (LAC) face novel challenges. Significant gaps in mutual understanding and intercultural competency remain among the peoples of the Americas, including and especially undergraduate students like those attending WPI. Filling these gaps is critical to improving multicultural relations, which, in turn, are essential to fostering socio-economic agreements and facilitating the transfer of knowledge and technology across nations. As the National Academy of Engineering's *14 Grand Challenges for Engineering in the 21st Century* states, "Through the engineering accomplishments of the past, the world has become smaller, more inclusive, and more connected. The challenges facing engineering today are not those of isolated locales, but of the planet as a whole and all the planet's people." To meet these challenges in the future, WPI's STEM students require skills to reach across linguistic, geographic, cultural, and disciplinary borders.

Since its establishment in 2018, the university's Latin American and Caribbean Studies Initiative has sponsored several successful activities on campus that have made preliminary steps to enhance our community's exposure to and knowledge of the region and build toward precisely the skills described above. The panel talks, guest speakers, student presentations, and artist performances have drawn significant attention and support from WPI's faculty, students, and administrators and have been well-attended and well-received by the local community. The initiative has also launched three new courses in Latin American and Caribbean Studies through collaboration with HUA's History and International and Global Studies disciplinary groups; its Steering Committee has won both internal and external grant monies to support efforts to make

LACS opportunities available to students during each of their four years at WPI. It will form a significant part of the new Global School, due to be launched in October 2020. Following the success of this initiative, and to further consolidate its undergraduate academic component, the Humanities and Arts Faculty and the Latin American and Caribbean Studies steering committee propose the creation of a Minor in Latin American and Caribbean Studies. The minor makes effective use of courses that have already been created and offered by the Spanish, International and Global Studies, and History divisions related to the region; its introduction coincides with an effort to further expand these offerings; and the minor draws on courses in Social Science and Policy Studies.

A Minor in Latin American and Caribbean Studies aims to give structure and guidance to the curricular paths and scholarly activities of our students in their exploration of global issues with specific emphasis on Latin America and the Caribbean. Such a minor harnesses WPI's academic strengths, advances its global curriculum, and amplifies its potential to make an impact on our student's education, intercultural and global competency, and long-term professional development.

B. Learning Outcomes and Assessment

By the end of the minor sequence, the students will have completed a total of 2 units of thematically integrated work in Latin American and Caribbean Studies. The LACS faculty believe that students who undertake this work, under the direction of their advisors, will complete the program with a wide-ranging understanding of the region, its history and culture, and its principal issues in a diversity of academic fields. Their growth in intercultural competency and understanding of global issues as they relate to Latin America and the Caribbean, gained from taking the courses listed herein, should be augmented by related engagement with the wider LACS initiative being developed at WPI—an initiative that includes the hosting of scholars and scholarly events on campus, expansion of research opportunities, and development of stronger relationships with partner institutions and communities in Worcester and the LAC region.

The program's faculty believe that the curriculum and course sequences outlined in this proposal will encourage students to engage with Latin America and the Caribbean beyond its requirements. The expectation is that a number of students in the program will complete their IQPs or MQPs at project centers in the region and pursue other curricular pathways and extracurricular activities that relate to LACS. And our aspirational objective is that students will build from their involvement with the minor in their personal and professional lives after the graduate from WPI.

We plan to conduct periodic reviews of the program to assess its effectiveness in achieving student enrichment and outcomes in the areas listed here.

C. Minor Requirements

The following description for the minor is proposed for the undergraduate catalog in the section with other minors in Humanities and Arts, (2020-21 UG catalog, p. 80):

LATIN AMERICAN AND CARIBBEAN STUDIES MINOR

The minor in Latin American and Caribbean Studies provides students with an opportunity to engage in the study of Latin America and the Caribbean beyond the Humanities and Arts Requirement. This interdisciplinary minor enables students to investigate issues and innovations that are important within Latin America and the Caribbean. It also allows students to explore topics in global studies from the perspectives of diverse groups and institutions in the region.

The Latin American and Caribbean Studies minor consists of two units of work selected from *either* Track One Spanish Sequence, *or* Track Two International and Global Studies/History Sequence. In addition to the courses listed in these two tracks, the minor advisor may approve other courses related to Latin American and Caribbean Studies, including those offered by other WPI departments and the HECCMA Consortium.

Track One: Spanish Sequence:

1. 1 unit selected from the following courses: SP 3523, SP 3524, SP 3525, SP 3526, SP 3529, SP 3531, SP 3533, SP 3534.

2. 1 unit selected from among INTL 1100, INTL 1300, INTL 2100, INTL 2310, INTL 2910*, HI 1313, HI 1345, HI 2316, HI 2328, HI 2930, HI 3341, HU 3900/3910*, PY/RE 2716, DEV 1200, DEV 2200. (*must be related to Latin America and the Caribbean)

Track Two: International and Global Studies/History Sequence:

1. 1 unit selected from the following courses: INTL 1100, INTL 1300, INTL 2310, HI 1345, HI 2930**,** or HU 3900/3910* (*must be related to Latin America and the Caribbean).

2. 1 unit selected from among INTL 1100, INTL 1300, INTL 2310, HI 1345, HI 2930**,** HI 1313, HI 2316, HI 2328, HI 3341, INTL 2100, INTL 2910*, PY/RE 2716, SP 3523, SP 3524, SP 3525, SP3 526, SP 3529, SP 3531, SP 3533, SP 3534, DEV 1200, DEV 2200, or HU 3900/3910* (*must be related to Latin America and the Caribbean). Courses that appear in Track Two list 1 and list 2 may be counted only once toward the requirements for the minor.

In both tracks, no more than one unit of work for the Humanities and Arts Requirement may be applied toward the Latin American and Caribbean Studies Minor. Any student at WPI is eligible to pursue the Latin American and Caribbean Studies Minor as long as at least one unit of work for these requirements does not overlap with the requirements for other minors or majors.

Note (not for inclusion in the catalog): Recognizing that other programs may not permit the use of HUA capstone inquiry seminars (HU 3900) and practicums (HU 3910) as credit toward fulfillment of the requirements for a minor, the LACS faculty believe its minor program should accept these classes as such. Doing so encourages students to take on seven-week-long independent investigative research projects on subjects related to Latin American and Caribbean Studies, thereby enhancing considerably student engagement with the region and its most pertinent issues.

D. Faculty

The following faculty members will have the responsibility of advising students pursuing a minor in Latin America and Caribbean Studies:

a. John S. Galante, Assistant Teaching Professor and Director of Latin American and Caribbean Studies, History and International and Global Studies, Dept. of Humanities and Arts
b. William San Martin, Assistant Teaching Professor, History and International and Global Studies, Dept. of Humanities and Arts
c. Aarti Madan, Associate Professor and Director of Buenos Aires Project Center, Spanish and International and Global Studies, Dept. of Humanities and Arts
d. Ángel A. Rivera, Professor, Spanish and International and Global Studies, Dept. of Humanities and Arts
e. Laureen Elgert, Associate Professor, SSPS and Co-Director of the Cuenca Project Center

In addition to courses offered by the faculty listed above, the following faculty members have agreed to include existing courses among those that qualify for the minor:

a. Holger Droessler (HUA)
b. Peter Hansen (HUA)
c. Jennifer McWeeny (HUA)
d. Geoffrey Pfeifer (HUA/Global School)
e. Jennifer Rudolph (HUA)

E. Expected Enrollment and Advising

Based on patterns and numbers of Spanish Minors at WPI, we expect to advise roughly 10 to 15 minors per year as the program is advertised in the following years.

Each student will select a faculty member of their preference in the field of Latin American and Caribbean Studies.

F. Resources

a. No new resources are required.

Appendix 1: Program Outline

	Track 1 - Spanish	Track 2 - INTL/History
Core unit = 3 courses	SP 3523, SP 3524, SP 3525, SP 3526, SP 3529, SP 3531, SP 3533, SP 3534	INTL 1100, INTL 1300, INTL 2310, HI 1345, HI 2930**,** HU 3900*
Elective unit = 3 courses	INTL 1100, INTL 1300, INTL 2100, INTL 2310, INTL 2910*, HI 1313, HI 1345, HI 2316, HI 2328, HI 2930, HI 3341, HU 3900*, PY/RE 2716, DEV 1200, DEV 2200	HI 1313, HI 2316, HI 2328, HI 3341, INTL 2100, INTL 2910*, PY/RE 2716, SP 3523, SP 3524, SP 3525, SP3 526, SP 3529, SP 3531, SP 3533, SP 3534, DEV 1200, DEV 2200
	*Requires advisor and course instructor approval; Course proposal under review	

Appendix 2: List of Relevant Courses and Instructors

Course Number	Course Title	Anticipated Instructor(s)
SP 3523	Topics in Latin American Culture	Madan, Rivera
SP 3524	Spanish-American Literature in the Twentieth Century	Madan, Rivera
SP 3525	Spanish-American Film/Media: Cultural Issues	Madan, Rivera
SP 3526	Comparative Business Environments	Madan, Rivera
SP 3529	Caribbeanness: Voices of the Spanish Caribbean	Madan, Rivera
SP 3531	Contemporary US Latino Literature & Culture	Madan, Rivera
SP 3533	*Ecocriticismo*: Environmental Cultural Production in Latin America	Madan, Rivera
SP 3534	Intersections of Science, Engineering, Art, Literature, and Film in Latin America and the Caribbean	Madan, Rivera
INTL 1100	Introduction to International and Global Studies	Galante, Hansen

INTL 1300	Introduction to Latin America	Galante, Rivera, Madan, San Martín
INTL 2100	Approaches to Global Studies	Galante, Hansen, Pfeifer
INTL 2310	Modern Latin America	Galante, Rivera, Madan, San Martín
INTL 2910*	Topics in Global Studies	Various
HI 1313	U.S. and the World	Droessler, Galante
HI 1345	Atlantic Worlds	Galante
HI 2316	Twentieth Century American Foreign Relations	Droessler
HI 2328	History of Revolutions in the Twentieth Century	Rudolph
HI 2930	Topics in Latin American History	Galante, San Martín
HI 3341	Topics in Imperial and Postcolonial Studies	Droessler
PY/RE 2716	Gender, Race, and Class	McWeeny
HU 3900*	HUA Inquiry Seminar	Various
DEV 1200	International Development and Society	Elgert
DEV 2200	Case Studies in Intl Development Policy and Engineering	Elgert
*Requires advisor and course instructor approval; Course proposal under review		

Minor Completion Form
MINOR IN LATIN AMERICAN AND CARIBBEAN STUDIES

Student Name/Email:
Student ID:
Major:
Anticipated Graduation Date:

Track Completed (check one):

_____ Spanish Sequence

_____ International and Global Studies/History Sequence:

Required Course Completion:

COURSE #	COURSE TITLE	TERM	GRADE	DOUBLE COUNTED*	LISTED OR APPROVED**
Unit 1 (3 courses)					
Unit 2 (3 courses)					

*Only three courses may be double counted toward the HUA requirement or another Minor/Major
**Courses not listed in the Minor program description in the course catalog require approval by the Minor advisor

Did you use HU3900/3910 to fulfill a requirement? Yes / No

Title/Description:
_____

Approval to use HU3900/3910 as a minor program requirement

_____

LACS Faculty Advisor Date

Minor Approval (includes approval of courses not listed in the course catalog as fulfilling Minor requirements)

_____

LACS Faculty Advisor Date

Date: December 10, 2020
To: WPI Faculty
From: Committee on Academic Operations (Prof. Mathisen, Chair)
Re: Motion to add HI 1345. ATLANTIC WORLDS approved by the History Disciplinary Group on 11/6/2020 and the Humanities and Arts Department on 11/6/2020.

Motion: The Committee on Academic Operation recommends and I move, that HI 1345. Atlantic Worlds, as described below, be added.

Course/Catalog Description:

HI 1345. Atlantic Worlds. Cat I

This introductory course reviews the history and legacies of Atlantic systems such a colonialism and migration that have connected Africa, the Americas, and Europe from the sixteenth century to the recent past. Taking a transregional approach to historical inquiry, the course places the Atlantic Ocean at its geographic center and explores the diverse people, cultures, ideologies, institutions, economies, and other phenomena that have traversed this ocean basin and connected the regions that line its shores. The course pays special attention to the technological, social, and political innovations, the systemic inequalities, and the heterogeneous notions of belonging that have emerged from transatlantic interactions and exchanges. The course can provide students with preparation for HUA depth in Global History and International and Global Studies as well as work at overseas project centers in regions often incorporated into Atlantic Worlds. No prior background is required.

Recommended background: None.

Anticipated Instructor: Professor John Galante

Rationale: Offered during A or B Term, this course will serve as an introduction to approaches in transregional history and other forms of scholarly inquiry that are not confined to particular nations or world regions. In placing equal emphasis on the participation of Africa, the Americas (Central, North, and South), and Europe – and people from those places – in the formation of Atlantic systems, the course will engage students with scholarship and perspectives from postcolonial, transnational, mobility, and race/ethnicity studies. It will also serve as a bridge between existing courses in U.S., European, and Latin American History; connect to higher-numbered courses in Global History like HI 2341 *Contemporary World Issues in Historical Perspective* and HI 3344 *Pacific Worlds*; and begin to fill a substantial HUA curriculum gap that exists in African History and African Studies. The course will also provide training and critical perspectives to students seeking a minor or major in International and Global Studies as well as students planning to complete degree requirements at project centers in many places that surround the Atlantic Ocean: Argentina, Ghana, Nantucket, Puerto Rico, South Africa, and the United Kingdom among them.

Implementation Date: Academic Year 2021-22.

Resource Needs: No new resources are required. John Galante is full-time faculty with a specialization in Atlantic History; the course replaces in his teaching load a section of "U.S. and the World" for which there will remain another section taught by Holger Droessler. Classroom needs are typical for HUA courses. No special information technology is required. Library resources are adequate to offer this course. The expected enrollment is 25, and the course type is Lecture/Discussion.

Impact on Distribution Requirements and Other Courses: This course will provide additional options for students completing the Humanities and Arts Requirement, the International and Global Studies Minor or Major, the forthcoming Latin American and Caribbean Studies Minor, the Humanities and Arts Major, and programs related to international development and the Global School.

Date: December 10, 2020
To: WPI Faculty
From: Committee on Academic Operations (Prof. Mathisen, Chair)
Re: Motion to add SP 3533 *Ecocriticismo*: Environmental Cultural Production in Latin America, approved by Modern Languages on 11/6/2020 and the Humanities and Arts Department on 11/6/2020.

Motion: The Committee on Academic Operations recommends and I move that SP 3533 *Ecocriticismo*: Environmental Cultural Production in Latin America, as described below, be added.

Course/Catalog Description:

SP 3533 *Ecocriticismo*: Environmental Cultural Production in Latin America. Cat II.

This upper-level Spanish course explores the many ways in which Latin American authors, artists, filmmakers, photographers, and thinkers have responded to environmental concerns from colonial times to present day. Starting with Europeans' first impressions of the New World, we will grapple with the interplay between local cultures and the expansion of global capitalism in Latin America by analyzing literary and cultural representations of, for instance, resource extraction of rubber, wood, and petroleum in the Amazon (Brazil, Perú, Ecuador); *maquiladora* contamination and environmental migration in the borderlands (U.S.-Mexico); water defenders and neoliberalism (Chile, Bolivia); indigenous social movements in defense of land & nature (Ecuador); eco-feminist parallels between oppression of women and nature (Honduras, Colombia); and natural disasters, especially in the age of the Anthropocene (Mexico, Puerto Rico). We will explore these issues and more to unearth the role of Latin American cultural production in bearing witness to and generating awareness of environmental crises. While always accounting for the region's complex and interwoven history of coloniality, inequality, and dependency, we will look for environmental justice solutions proposed at the intersection of art and activism. Several questions will guide our interpretations, which will be grounded in ecocritical theory: what do the studied works aim to achieve by appealing to harmony between the human and the non-human? What similarities or differences exist across countries, contexts, and genres? And how does Latin America's ecological consciousness differ from that of other peripheries and centers? This course would be especially beneficial to students interested in project work at WPI's Project Centers in Latin America and the Caribbean and would count toward the HUA Requirement in Spanish, International and Global Studies, and Latin American & Caribbean Studies.

Recommended background: Advanced Spanish and content courses related to Latin America

Anticipated Instructors: Aarti Madan and Ángel Rivera

Rationale: This new course is part of an interdisciplinary initiative to strengthen WPI's curricular and co-curricular resources devoted to Latin America and the Caribbean. Its focus on environmental cultural production in the region will introduce students to a suggestive sample of the region's most pressing issues and illuminate, through a humanistic lens, a variety of literary

and artistic responses. By delving deep into matters of environmental social justice, this course will fill a gap in the Spanish curriculum and offer a two-fold cultural and linguistic benefit to students undertaking project work in Argentina, Ecuador, Costa Rica, Puerto Rico, Paraguay, and Panama. This course will also offer training and critical perspectives to students completing their HUA Requirement, Minor, or Major in Spanish or International and Global Studies while also serving as an elective for the SSPS Environmental Studies sequence.

Implementation Date: Academic Year 2022-23.

Resource Needs: No new resources are required. Aarti Madan and Ángel Rivera are full-time faculty with expertise in Latin American literary and cultural studies. This course would be offered on a rotating basis in lieu of D-Term SP 3526 Comparative Business Environments. Classroom needs are typical for HUA courses. No special information technology is required. Library resources are adequate to offer this course. The expected enrollment is 25, and the course type is Lecture/Discussion.

Impact on Distribution Requirements and Other Courses: This course will provide a timely and relevant option for students completing the Humanities and Arts Requirement, the International and Global Studies Minor or Major, the forthcoming Latin American and Caribbean Studies Minor, the Humanities and Arts Major, and programs related to Environmental Studies and the Global School.

Date: December 10, 2020
To: WPI Faculty
From: Committee on Academic Operations (Prof. Mathisen, Chair)
Re: Motion to add SP 3534 Intersections of Science, Engineering, Art, Literature, and Film in Latin America and the Caribbean, approved by Modern Languages on 11/6/2020 and the Humanities and Arts Department on 11/6/2020.

Motion: The Committee on Academic Operations recommends and I move that SP 3534 Intersections of Science, Engineering, Art, Literature, and Film in Latin America and the Caribbean, as described below, be added.

Course/Catalog Description:

SP 3534 Intersections of Science, Engineering, Art, Literature, and Film in Latin America and the Caribbean. Cat II.

This course explores past and present intersections between the arts and sciences in Latin America and the Caribbean through a multidisciplinary and interdisciplinary approach. The purpose of this course is to examine areas or interaction between the arts, films, and literature with selected areas of knowledge related to STEM. In this manner, Latin America and the Caribbean are represented as in a creative and critical dialogue with aspects of Modernity and Modernization. This course is especially appropriate for students who expect to complete their IQP and MQP WPI project centers in Latin America and the Caribbean.

This course proposes a set of concentrated modules to explore such intersections. For example:

Module 1: Ancient Civilizations (Aztecs, Mayas and Incas) and Engineering/Sciences
Module 2: Case studies of scientific developments and technological revolutions in Latin America.
Module 3: Selection of IQP's developed about Latin America /Caribbean by WPI students for analysis and discussion.
Module 4: Selection of literary texts (in translation or in Spanish) and how they relate to Modernity and the processes of Modernization.
Module 5: Selection of films in relation of representations of the impact of technology in human life.
Module 6: Selection of Science Fiction texts produced in Latin America and the Caribbeanand visions of how scientific knowledge related to new subjectivities
Module 7: Oral presentations from students of their areas of interest and their connection to possible impacts on Latin American/Caribbean societies.

Recommended Background: Advanced Spanish and content courses related to Latin America and the Caribbean

Anticipated Instructors: Prof. Aarti Madan and Prof. Ángel Rivera

Rationale: This new course is part of an interdisciplinary initiative to strengthen WPI's curricular and co-curricular resources devoted to Latin America and the Caribbean. It is designed for students with a general interest in Latin America and the Caribbean: those completing the Humanities and Arts requirement, those with plans to go to WPI project centers in the region, and those who return and want to enrich and extend their engagement with Latin American affairs.

In this course, students will develop the capacity to identify, explain, and critically analyze the topics it addresses and interrogate their own position in relation to these topics.

Implementation Date: Academic Year 2022-23.

Resource Needs: No new resources are required. Aarti Madan and Ángel Rivera are full-time faculty with expertise in Latin American and Caribbean literary and cultural studies. This course would be offered on a rotating basis in lieu of C-Term Technical and Business Spanish. Classroom needs are typical for HUA courses. No special information technology is required. Library resources are adequate to offer this course. The expected enrollment is 25, and the course type is Lecture/Discussion.

This course is dependent on media and it requires a classroom with media capabilities. Library resources are adequate to offer this course. The manner of conducting the course is based on Lecture/Discussion/Writing.

Impact on Distribution Requirements and Other Courses: This course will provide additional options for students completing the Humanities and Arts Requirement, the Requirement for Spanish, the International and Global Studies Minor or Major, the forthcoming Latin American and Caribbean Studies Minor, the Humanities and Arts Major, and new programs related to international development.

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Rolle, Chair)
Re: Motion to explicitly state the waiving option for the RBE 500 course requirement in the graduate catalog.

Motion*:* The Committee on Graduate Studies recommends and I move to add the explanations below (in the red font) to the graduate catalog for notifying the students about the possibility to substitute the "RBE 500 Foundations of Robotics" course requirement with credits from more advanced RBE courses other than RBE 594, RBE 596, RBE 597, RBE 598, RBE 599 and RBE 699.

1. Robotics Core (15 credits)*
   - Foundations (9 credits)

   RBE 500 Foundations of Robotics *(**)*
   RBE/ME 501 Robot Dynamics
   RBE 502 Robot Control
   - Core (6 credits)

   Any RBE 500+ other than the above.
   (*) At least 15 credits are needed. Any additional credits accrued from these courses will be counted as Electives.
   (**) Students may apply to substitute the RBE 500 requirement with credits from more advanced RBE graduate courses other than RBE 594, RBE 596, RBE 597, RBE 598, RBE 599 and RBE 699. This requires taking an equivalent course/training prior to starting to the graduate program at WPI, and the students are required to submit a petition to the RBE Graduate Program Committee for approval. Such approvals must be filed with the Registrar within one year of the date of matriculation in the program as detailed on page 22 of the graduate catalog.

Proposed Modifications to Graduate Catalog: To page 179 of the 2020-2021 Graduate Catalog, under the "For the M.S." section and under the "1. Robotics Core" section, we propose adding the text outlined above with red and italic font.

Rationale: RBE 500 is designed as a ramp up course for the graduate students, who do not have prior robotics education and experience. Students who start the graduate program with prior robotics knowledge would not benefit from the course. We have seen that such students quickly lose interest to the topics covered in RBE 500, and create a significant knowledge discrepancy in the class, challenging and discouraging the other students. Because of these reasons, the RBE GPC thinks that if these students skip this class and take more advanced RBE courses, it is better for both these students themselves and the other students in the RBE 500 class. The change has been voted on and approved by the RBE faculty.

We reference the common language in the Graduate Catalog (20-21 edition, pg. 22) regarding the logistics of this petition, which reads:

> "With the appropriate background, a student may ask permission to waive a required course and substitute a specified, more advanced course in the same discipline. Requests

are subject to approval by the student's program and must be filed with the Registrar within one year of the date of matriculation in the program. A program may waive (with specified substitutions) up to three required courses for a single student."

Impact on Degree Requirements: This change itself does not have a direct impact on the degree requirements; it only notifies the student to the possibility of submitting a petition to waive a requirement.

Implementation Date:
The policy will go into effect during Spring 2021 semester, and revisions will be included in the AY2021-2022 catalog.

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Marsha Rolle, Chair)
Re: Motion to approve revisions to an existing graduate program, **MBA**. This motion was approved by the Foisie Business School on Oct 7, 2020.

Motion: The Committee on Graduate Studies and Research recommends, and I move that the existing graduate program, Master of Business Administration (MBA), be revised, as described below.

Summary: (*Overview of what is being proposed and why.)*
Based on enrollments, MBA is still the largest graduate degree program in the U.S. MBA conferrals in the U.S. have seen a moderate decline since reaching a 2012 peak of nearly 117,000 conferrals, but still remains above 100,000 in 2019. This has resulted in increased competition among the approximate 1,000 MBA program offerings still in the market. That competition has led to shorter degrees, often with a smaller set of core/required courses. Our 48-credit MBA is now viewed as too long and too expensive. For example, the total cost now exceeds what most corporations, e.g., UTC, provide as educational benefits.

We propose to change FBS's MBA program as follows:

- Shorten it from 48 credits (16 3-credit courses) to 36 credits (12 3-credit courses) and to reduce our required courses from 14 to 7. This is a substantial change, designed to make our MBA program competitive in the current market.
- Align it more directly with the technology and analytics strengths of FBS, so that it is STEM-focused.
- Structure it based on the new *core and specialty* stackable design implemented in our MS IT and MS BA programs that we redesigned last year. This enables the MBA program to draw from the core and specialties within these programs thereby offering economies of scale.

The revised program is comprised of existing FBS graduate courses, with some revisions to these courses. This revision involves re-structuring and updating of both the courses and the overall program, with no need for additional courses and no need for new resources.

Proposed Modifications to Graduate Catalog:
(ALL relevant sections to be added to the graduate catalog should be included. Remember, the graduate catalog is a contract with our students. Specifically, the following should be addressed:)

Program Goals and Objectives:
Current Catalog version:
WPI's MBA program is aimed at STEM professionals seeking the skills to strategically manage organizations. The curriculum features the core business disciplines in the context of tech-driven environments; courses to lead and inspire people; a focus on technology commercialization and the latest developments in a variety of STEM industries; and culminates in a team-based capstone project.

New Catalog version:
Technology permeates every aspect of an organization, constraining and enabling its operations and strategy. Therefore, in this dynamic and rapidly transforming era, it is imperative to integrate technology and business strategy. The Foisie Business School MBA is specifically designed for STEM (Science, Technology, Engineering, and Mathematics) professionals, leveraging the expertise of its faculty in this tech-business connection. Students will develop data-driven, strategic decision-making skills using state-of-the-art tools and technologies, as well as soft skills and professional competencies that will complement their technical expertise. This will prepare them for management roles in technology-driven organizations. Students will cultivate these skills in a project-based, asynchronous online learning environment.

- Gain foundational knowledge of key business functions such as finance, marketing, information technology, and operations management.
- Specialize in their area(s) of interest through several specialized concentrations offered in this program such as finance analytics, marketing analytics, operations analytics, business analytics, user experience, information systems design, and others.
- Benefit from the capstone experience that enables them to revise, integrate, and apply their knowledge and skills.
- Develop evidence-based problem solving, leadership, and team skills in a project-based learning environment at the intersection of theory and practice.
- Build connections within STEM and business academia (professors) and industry (peers, experts, and employers).

Admissions Requirements:
The admission requirements remain the same as currently stated in the graduate catalog as updated on MBA website, which are:

- Applicants should have the analytic aptitude and academic preparation necessary to complete a technology-oriented business program. This includes a minimum of three semesters of college level math or two semesters of college level calculus.
- Applicants must have earned the equivalent of a four-year U.S. bachelor's degree to be considered for admission.
- A minimum of two years post graduate professional work experience is required.
- GMAT or GRE is not required.

Faculty Contacts: Purvi Shah, Diane Strong.

Requirements for the Master in Business Administration (MBA) – 36 credits:
The MBA is designed as a stackable, professional master's degree. As such, it involves a realistic capstone project. It does not provide options related to a research degree (e.g., no provision for research credits, qualifying exams, a thesis option, or research seminars).
(For the prior structure of the MBA, see p.51 in the current graduate catalog.)

Notes on Delivery mode: This program will be offered entirely online, with some courses having optional synchronous sessions. We may also offer an MBA cohort at special sites or on-campus when and if there is sufficient demand.

Requirement 1: MBA students must complete a five-course core that introduces five foundational areas of business as follows:

- Financial foundations: FIN 500 Financial Management
  (title revision to current FIN 500)
- Information systems foundations: MIS 584 Business Intelligence
  (description revision to current MIS 584)
- Marketing foundations: MKT 500 Marketing Strategy
  (title and description revision to current MKT 500)
- Organizational behavior foundations: OBC 506 Leadership
  (title and description revision to current OBC 506)
- Operations foundations: OIE 501 Operations Management
  (title and description revision to current OIE 501)

Students with sufficient coursework or expertise in one of these five areas of business may petition to take a more advanced course in that area instead of the foundation course listed above. For example, a student with 5-years of experience in operations management might petition to take a course focused on Supply Chain Analysis instead of the operations foundation course.

Requirement 2: MBA students must complete a course that is integrative across the five core courses, provides a strategic view of STEM-oriented businesses, and prepares students for the capstone.

- BUS590 Strategic Management
  (title and description revision to current BUS 590)

Requirement 3: MBA students must complete one three-course specialty (all three courses must be FBS courses), selected from:

- Any of the specialties or the cores defined for FBS's specialty MS programs, for which three FBS courses can be selected. These include:

Any specialty from MS in Business Analytics	Any specialty from MS in Information Technology
• Business Analytics Core	• Information Technology Core
• Advanced Business Analytics Methods	• Information Systems Design
• Marketing Analytics	• IT User Experience
• Finance Analytics	• Digital Transformation
• Operations Analytics	• Data Analytics

- New specialties defined for the MBA program (see below).
- Additional MS or MBA specialties developed in the future.
- Custom specialties that are available by petition

Proposed new specialties for the MBA program:

- **Entrepreneurship**
  - ETR 500 Entrepreneurship and Innovation
  - Any two from the following courses:

        - ETR 593 Technology Commercialization: Theory, Strategy, and Practice
        - ETR 596 Selling and Sales
        - BUS 500. Business Law, Ethics and Social Responsibility
- **Product Management**
    - MKT 569 Product and Brand Management
    - OBC 533 Negotiations
    - Any one of the following:
        - ETR 593 Technology Commercialization: Theory, Strategy, and Practice
        - MIS 576 Project Management
        - MIS 585 User Experience Design
        - MKT 565 Digital and Social Media Marketing
        - OBC 505 Teaming and Organizing for Innovation
        - OBC 535 Managing Creativity in Knowledge Intensive Organizations
- **Project Management**
    - MIS 576 Project Management
    - OBC 533 Negotiations
    - Any one of the following:
        - MKT 569 Product and Brand Management
        - OBC 505 Teaming and Organizing for Innovation
        - OBC 535 Managing Creativity in Knowledge Intensive Organizations

Requirement 4: MBA students must complete two electives, both of which must be FBS courses.

- All FBS graduate courses qualify as electives.
- If the two courses are part of an existing 3-course specialty or core for which the third course was taken as part of the MBA core, students will receive the specialty or core designation as part of their degree.
- Students with little or no business background are encouraged to select their electives as additional financial or organizational or business law courses, especially if their selected specialty does not include such knowledge.

Requirement 5: MBA students must complete a capstone project experience as follows:

- BUS 599 MBA Capstone Project

New Course Descriptions:
No new courses are being proposed.

Revised Course Descriptions (and Titles) for Existing Courses
As part of this proposal, we are updating our course titles and/or descriptions for five MBA core courses and the integrative strategy course, all of which are existing courses.

BUS 590 – Revise Course Title and Description
Current title and description
BUS 590 Strategy in Technology-based Organizations (3 credits)
This course provides a summary overview of strategic management, with a focus on integrating the core curriculum to develop competitive advantage at the corporate and business unit level. Topics include the role of the CEO in the organization, industry analysis, the use of core

competence to drive business development and exit decisions, causes of organizational inertia that cause the loss of competitive advantage, the impact of technology on strategy, the links between strategy and organizational design, and the social responsibility of the firm. The course also serves as the initial phase of BUS 599 (Capstone) and is designed to be taken immediately preceding that class. (Prerequisites: ACC 500, ACC 502, ACC 505, BUS 500, FIN 503, FIN 504, MIS 500, MKT 500, OBC 505, OBC 506 and OIE 501 or equivalent content, or instructor consent) (Students cannot get credit for BUS 590 and BUS 501)

Revised (title and description)

BUS590 Strategic Management (3 credits)

This integrative and interdisciplinary course provides a broad overview of strategic management, with a focus on technology-driven organizations. Adopting a general management perspective, students will learn how to develop and execute a holistic corporate strategy that integrates key functional and business unit level strategies. Topics include data-driven strategy formulation, implementation, and evaluation. This course integrates the MBA core courses, and therefore should be taken after completing all core courses. It also serves as a prerequisite for the capstone project so it must be taken before the final capstone course (BUS 599).

FIN 500 – Revise Course Title and Description.

Current title and description

FIN 500 Financial Information and Management (3 credits)

This course develops expertise in financial decision-making by focusing on frequently used financial accounting information and the conceptual framework for managing financial problems. Students are introduced to the accounting and financial concepts, principles and methods for preparing, analyzing and evaluating financial information, for the purpose of managing financial resources of a business enterprise and investment decisions. The course adopts a decision-maker perspective by emphasizing the relations among financial data, their underlying economic events, and corporate finance issues. The course provides an overview of the financial reporting system, to enable data analysts in building queries for financial analyses and in forecasting possible future financial scenarios.

Revised (title and description)

FIN 500 Financial Management (3 credits)

This course develops students' financial expertise. The course focuses on financial management and corporate finance. Students learn accounting and financial concepts, principles, and methods for preparing, analyzing, and evaluating financial information, for the purpose of managing financial resources of a business enterprise and making investment decisions. Students are also introduced to the principles and methods of valuation. Students practice with the financial reporting system which enables data analysts to build queries for financial analyses and to forecast possible financial scenarios. Finally, this course focuses on financial strategy and planning to enable internal managerial decisions. Students will learn and apply budgeting techniques and manage working capital.

MIS 584 – Revise Course Description only

Current title and description

MIS 584 *Business Intelligence* (3 credits)

Today's business computing infrastructures are producing the large volumes of data organizations need to make better plans and decisions. This course provides an introduction to the processes, technologies, and techniques for organizing, analyzing, visualizing, and interpreting data and information about business operations in a way that creates business value. During the course, students will study a variety of business decisions that can be improved by analyzing data about customers, sales, and operations, preparing students to be knowledgeable producers and consumers of business intelligence. Students will apply commercially available business intelligence software to develop performance dashboards to facilitate organizational decision-making. The course explores the technical challenges of organizing, analyzing, and presenting data and the managerial challenges of creating and deploying business intelligence expertise in organizations. The course includes business cases, in-class discussion, and hands-on analyses of business data. It is designed for any student interested in learning about data-driven business performance management and decision-making, including students whose primary focus is Data Science, IT, Marketing, Operations, or Business Management.

Revised (description only)

MIS 584 *Business Intelligence* (3 credits)

This course provides students with the knowledge and skills to design, develop, and use business dashboards for monitoring organizational performance and making data-driven decisions. On the technical side, students will learn and apply business intelligence software to organize, represent, and analyze data about customers, products, sales, marketing, operations, and financials. They will learn to create strategic, operational, and analytical dashboards displaying key performance indicators (KPIs) for managerial decision-making. On the business side, students will learn the connections between business strategy and plans, the KPIs that measure performance compared to those plans, and how to use dashboards to manage organizational performance. Students will also learn the technical and managerial challenges of creating and deploying these business intelligence best practices so that organizations gain value from their data. The course includes business cases and hands-on analyses of business data. It is designed for any student interested in learning about data-driven business performance management, including students whose primary focus is Business Management, Data Science, IT, Marketing, or Operations.

MKT 500 – Revise Description only

Current title and description

MKT 500 *Marketing Strategy* (3 credits)

This course focuses on the development and marketing of products and services that meet customer needs. Topics covered include management and the development of distinctive competence, segmentation and target marketing, market research, competitor analysis and marketing information systems, product management, promotion, pricing strategy, and channel management. Students will learn how the elements of marketing strategy are combined in a marketing plan based on marketing analytics, and the challenges associated with managing products and services over the life cycle, including strategy modification and market exit.

Revised (description only)

MKT 500 *Marketing Strategy* (3 credits)

This course enables students to draw insights from data to formulate effective marketing strategies that benefit the organization and its stakeholders. Students will learn to (1) identify and understand consumers' value needs (marketing research and consumer behavior), (2) create an attractive value proposition (product and pricing strategies and tactics), and (3) communicate and deliver this value proposition (promotion and distribution strategies and tactics). Upon successful completion of this course, students will be able to develop and execute an effective data-driven marketing plan to achieve an organization's financial and marketing goals. Experiential learning techniques will be used to impart this knowledge and develop these skills.

OBC – Revise Course Title and Description
Current title and description

OBC 506. *The Heart of Leadership: Power, Reflection, And Interpersonal Skills* (3 credits)

All of us hope to have positive, collaborative, and effective interactions with others—in our professional and personal lives. Yet often our interactions do not go as planned and it gets ugly: people behave irrationally and get emotional, communication stops, conflicts fester, and opportunities are left unrealized and obscured. This course develops skills for understanding and acting more powerfully, ethically, and mindfully in our interactions. These include analytic techniques for understanding emotional, biographical, and social-psychological reasons for our own and others behavior, and skills for paying attention to and managing the complex dynamics unfolding in interpersonal interactions. Students will learn to identify and reflect upon their own contributions to problematic interactions; design and execute better ways of interacting with others; and develop their own interpersonal strengths and collaborative capacities. (Prerequisite: OBC 505 or instructor consent) (Students cannot get credit for OBC 506 and OBC 501)

Revised (title and description)
OBC 506. *Leadership* (3 credits)
How do we mobilize our own and others' energy toward developing sustainable outcomes and meaningful change—when the path ahead is unclear, when our business environment is rapidly changing, when we do not have full authority over those involved? This course embraces a human-centered design approach to leading others with integrity, empathy, and curiosity—with a specific focus on the unique challenges and opportunities of working within project-based networks and Industry 4.0/STEM contexts. Students will build their capacity to navigate complex human and technical systems as they work in teams to develop and pilot a solution to a real-life organizational or social problem.

OIE – Revise Course Title and Description
Current title and description

OIE 501. *Designing Operations for Competitive Advantage* (3 credits)

The operations function in an organization is focused on the transformation processes used to produce goods or provide services. Operations design is driven by strategic values, and innovative improvements can support sustained competitive advantage. In this course, a variety of analytical and statistical techniques are introduced to develop a deep understanding of process behavior, and to use this analysis to inform process and operational designs. Topics such as process analysis and value stream mapping, postponement and global and local supply chain strategies, queuing models, and managing system constraints are covered using case studies and hands-on activities such as on-line simulations. Non-traditional operations systems are also explored. The skills required to model an operational system, to reduce variation and mitigate bottlenecks, to effectively present resource needs, and to adjust capacity and inventory service levels are practiced during the course. (Students cannot get credit for OIE 501 and OIE 500)

Revised (title and description)

OIE 501. *Operations Management* (3 credits)

This course focuses on the data-driven decision-making that matches supply to demand in an organization and its supply chain, emphasizing the strategic impact of operations on competitiveness and sustainability. Emergent technologies are explored as opportunities for innovation. Descriptive, predictive, and prescriptive analytical techniques are introduced to structure and evaluate key operational decisions. Skills required to model a system's operations, to address uncertainty and mitigate risk, to effectively evaluate resource needs, to integrate components into a coordinated system, and to efficiently develop and manage capacity and inventory are honed during the course.

Courses to Remove from the Catalog

This proposal shortens the MBA program, which means a few courses are no longer needed. Some courses no longer required will be retained as electives. We propose removing the following courses that are no longer required in any program and are not needed as electives.

- BUS 595 THE EDGE OF TECHNOLOGY IN STEM INDUSTRIES (3 credits)
- ACC500 ACCOUNTING AND FINANCE FUNDAMENTALS (1 credit)
- ACC502 FINANCIAL INTELLIGENCE AND STRATEGIC DECISION-MAKING (2 credits)
- ACC505 PERFORMANCE MEASUREMENT AND MANAGEMENT (1 credit)
- FIN504 FINANCIAL STATEMENT ANALYSIS AND VALUATION (2 credits)

Rationale: *(Explain the need for the degree or program, and the value of offering it.)*
FBS has offered an MBA program since the late 1970's, typically with both on-campus or remote/distance/online offerings. It has been revised both in major and minor ways over that time, including a recent revision. The MBA landscape has changed significantly in the last few years, necessitating a major revision now. Furthermore, we plan to launch this revised MBA in Fall 2021 with an online program management (OPM) vendor, All Campus. All Campus has significant experience in marketing and recruiting MBA students and knows what aspects of MBA curricula appeal to students. Thus, this redesign includes knowledge from the changed MBA competition, from the new core/specialty structure from our revised MS programs, and from our conversations with All Campus. Consistent with the success of WPI's project-based learning curriculum, we will continue to include the capstone project, which has been in our MBA program since the 2010/11 curriculum revision.

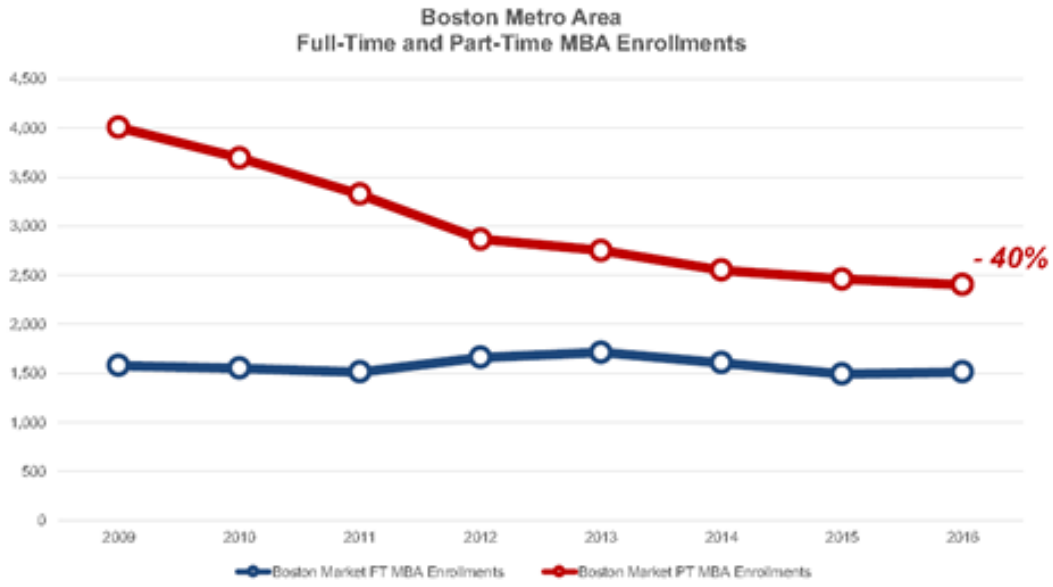
Opportunity and Market Analysis: *(An assessment of the need for the program and potential student interest.)*
Current market developments are driving continued interest in a business program that understands STEM professionals and integrates a STEM focus into to a program that provides the core elements of a traditional business program.

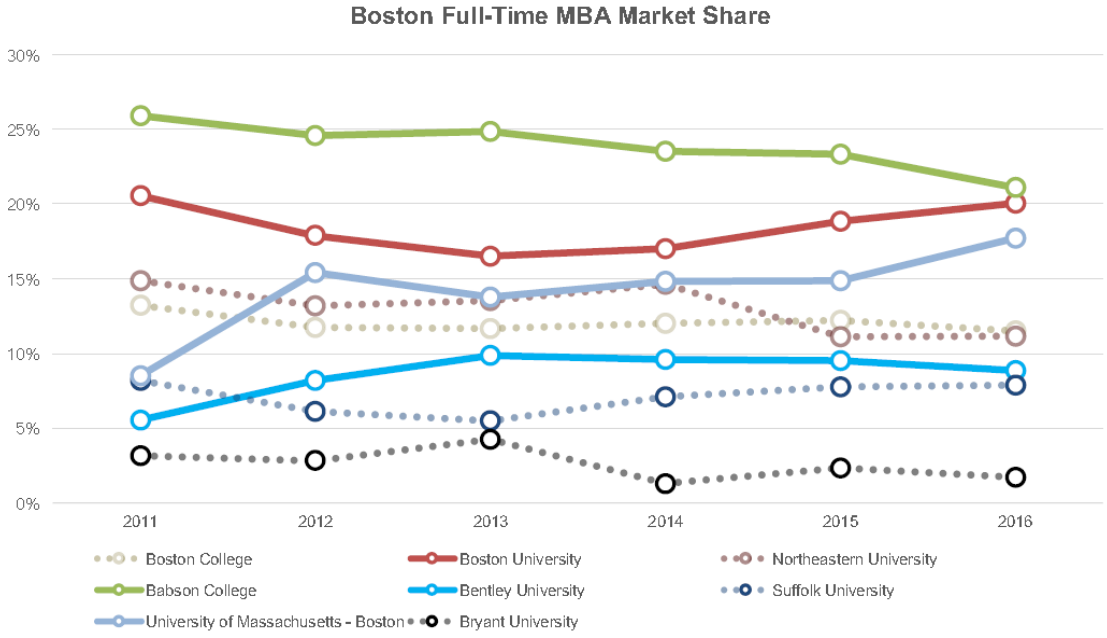
A large portion of students that enroll in MBA programs still draws on a local population even when they are fully online. There are 30,000 engineers and STEM professionals in the target 22 to 39-year-old demographic within a 50-mile radius of WPI. The target audience domestically is very large and would be in the prospect pool being targeted by our external Online Program Manager.

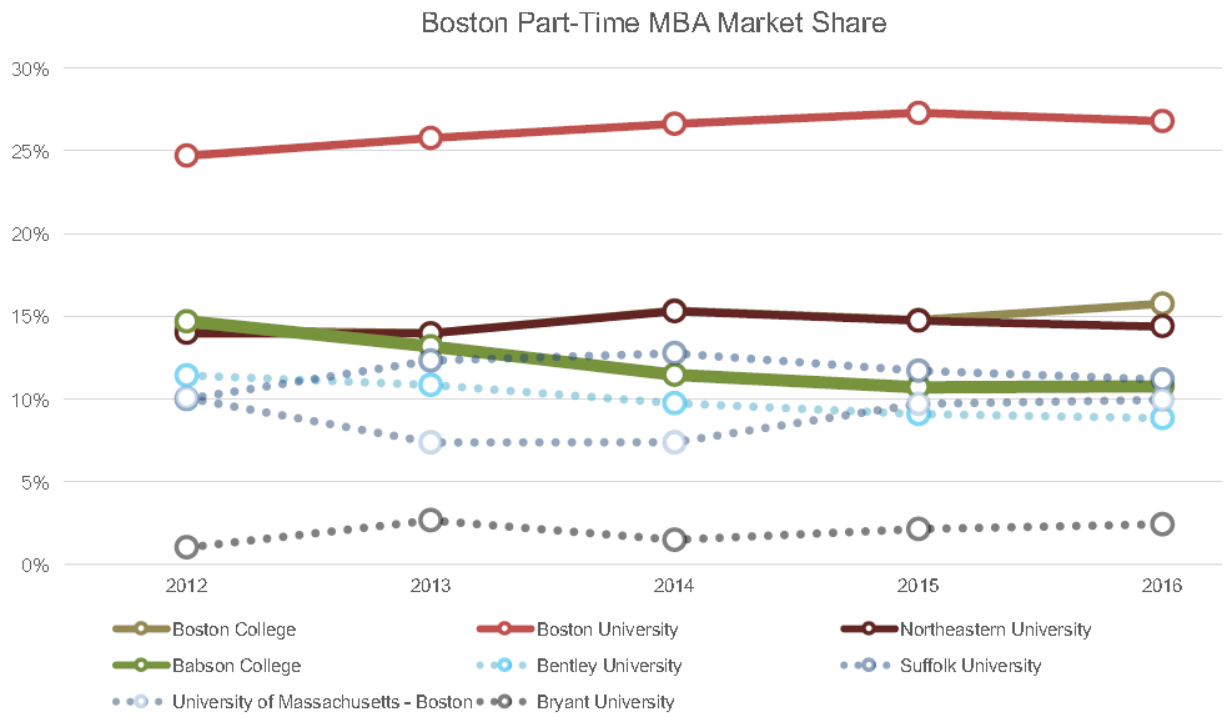
Comparison to Existing Programs at WPI:
This motion is a revision of our current MBA program. It maintains the same quality and rigor of the current MBA degree.

Impact on Existing Programs at WPI:
We expect no impact on existing programs at WPI.

Comparable Programs at other Universities: (if relevant)
The following exhibits provide data on the Boston Metro and greater area markets and support the trends of MBA conferral declines, primarily in part time enrollments. The first three exhibits focus on the Boston Metro market. The final exhibit compares a revised WPI MBA offering relative to other programs. If we kept the program as is, WPI's MBA offering we only be less expensive than Syracuse University and Babson College.


Boston Metro Area
Full-Time and Part-Time MBA Enrollments
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
2009
2010
2011
2012
2013
2014
2015
2016
- 40%
Boston Market FT MBA Enrollments
Boston Market PT MBA Enrollments


Boston Full-Time MBA Market Share
30%
25%
20%
15%
10%
5%
0%
2011
2012
2013
2014
2015
2016
Boston College
Boston University
Northeastern University
Babson College
Bentley University
Suffolk University
University of Massachusetts - Boston
Bryant University



Search Volume	U.S. News Ranking			Institution	Program Name	Total Tuition	Cost Per Credit Hour	Total Credits	# Concentration Options
	Full-Time MBA (2021)	Part-Time MBA (2021)	Online MBA (2020)						
165,000	77	unranked	54	Syracuse University	M.B.A	$90,882	$1,683	54	7
49,500	72	66	unranked	Babson College	M.B.A	$89,550	$1,990	45	7
165,000	61	77	102	Northeastern University	M.B.A	$69,700	$1,394	50	8
110,000	unranked	154	40	Hofstra University †	M.B.A.	$66,915	$1,487	45	12
40,500	unranked	unranked	unranked	Clark University	M.B.A.	$57,180	$4,765/course	12 courses	7
90,500	89	unranked	28	Rochester Institute of Technology	M.B.A.	$55,977	$1,191	47	0
90,500	unranked	unranked	unranked	Pace University	M.B.A.	$52,416	$1,344	39	0
49,500	unranked	89	34	Bentley University	M.B.A.	$51,240	$5,124/course	10 courses	8
6,600	unranked	unranked	95	SUNY Polytechnic Institute *	M.B.A. in Technology Management	$49,488	$1,031	48	1
27,100	89	unranked	83	Clarkson University	M.B.A.	$49,308	$1,174	42	4
40,500	unranked	unranked	unranked	Iona College	M.B.A.	$44,928	$1,248	36	0
33,100	unranked	135	40	University of New Hampshire *	M.B.A.	$43,680	$910	48	7
40,500	unranked	unranked	179	Suffolk University	M.B.A.	$43,668	$1,213	36	4
5,400	unranked	unranked	unranked	Albertus Magnus College	M.B.A.	$42,240	$880	48	4
8,100	unranked	unranked	unranked	St. Thomas Aquinas College	M.B.A.	$40,365	$1,035	39	5
27,100	unranked	unranked	unranked	Molloy College	M.B.A.	$39,435	$1,195	33	4
27,100	unranked	unranked	unranked	Worcester Polytechnic Institute	M.B.A.	$37,440	$1,040	36	N/A
49,500	unranked	141	unranked	Fairfield University	M.B.A.	$36,360	$1,010	36	8
90,500	53	28	28	UMass-Amherst	M.B.A	$35,100	$900	39	5
40,500	unranked	unranked	unranked	Mercy College	M.B.A.	$34,128	$948	36	8
18,100	unranked	unranked	unranked	Western New England University	M.B.A.	$33,084	$919	36	4
40,500	unranked	unranked	35	Quinnipiac University	M.B.A.	$32,835	$995	33	0
40,500	unranked	unranked	161	Monroe College	M.B.A.	$32,148	$893	36	11
9,900	unranked	unranked	unranked	Hult International Business School ††	M.B.A.	$32,000	$1,391/course	23 courses	0
33,100	unranked	unranked	unranked	Endicott College	M.B.A.	$31,962	$761	42	18

* Non-Resident Tuition † 38-credit option available for qualifying undergraduate business degree ($52,506) †† Two required residencies in Boston

Implementation:

Program Management

This program is the responsibility of our Interdisciplinary Policy and Curriculum Committee (IPCC), that manages the MBA and MS MG programs, current chair Professor Purvi Shah. Changes to the program, student petitions, etc. will all go through this committee. Operationally, the FBS faculty are responsible for program delivery and the FBS program staff are responsible for program management. Significant operational support for non-academic activities (e.g., admissions, fee-paying, registering for courses, etc.) is provided by the OPM vendor (primarily for domestic students) and the WPI graduate programs office (primarily for international students).

Implementation Date

Targeted start for implementation is Fall 2021, in conjunction with our OPM vendor, All Campus.

Transition Plans

We are working on three sets of transition plans, based on the three different ways the current MBA program and its courses are offered:

- Students in the FBS-delivered blended MBA program will transition into the new MBA program. Because the new program is 36 credits rather than 48, we expect no students to want to stay in the existing program. We will specify how the courses taken by on-going MBA cohorts map into the new program. No students will be penalized in the transition.
- Students in the CPE-delivered MBA at company sites will also not want to stay in a 48-credit program. Since these MBA cohorts at companies have already moved online, we have started a transition to merge FBS and CPE cohorts so that there are not separate courses offerings for each audience after a transition period.
- Other programs now delivered through OPE (formerly CPE) include one or more business courses. We are exploring with OPE how we might merge online sections of the same course offered during the same time period.

Resources Required:

No new resources are required because there are no new courses. In the future, we may need more resources if the program grows as we expect.

A financial plan is not required but may be included.

This revision should produce a net reduction in costs of delivering the MBA program because we can merge students that were in small sections using different delivery modes into one online course offering.

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Marsha Rolle, Chair)
Re: Motion to modify policies related to Academic Standards for Graduate Students

Motion: The Committee on Graduate Studies and Research recommends, and I move, that the following Graduate Catalog section on non-degree student course limits be modified as described below.

Background and Rationale:
The current wording in the graduate catalog allows students to take up to four graduate courses before formally applying to a graduate degree or certificate program. However, there are certificates that require only 12 credits; therefore a student could theoretically complete all of the courses for a certificate without applying for admission to the certificate program. Both the Foisie School of Business and CPE already limit non-degree students to 6 credits before matriculating to a degree program. Since we cannot necessarily tell which degree a student is working toward before they apply, it is not possible to consistently reach out to non-degree students in a timely manner and encourage them to apply in order to earn the degree they are working toward.

The motion proposes a uniform, university-wide limit on the number of credits (6 credits) that a non-degree student may take for credit to meet degree requirements before applying for admission to a WPI graduate degree program. By making this limit consistent across departments, it will be clear which students (regardless of department or program) have reached the non-degree credit limit, which will facilitate WPI's ability to communicate clearly and consistently to these students.

Proposed revisions (additions *underlined* and deletions ~~struck through~~)
Page 13 of Graduate Catalog
Advanced Study for Non-Degree Students
Individuals with earned bachelor's degrees may wish to enroll in a single course or a limited number of courses prior to applying for admission to either a certificate or degree program. Non-degree students may choose to be graded conventionally (A, B, C), or on a pass/fail basis. Pass/Fail grading must be chosen at the time of registration, and courses taken on the pass/fail basis are not transferable to any master's degree program.
Non-~~admitted~~ *degree* students may take a maximum of *6 credits* ~~four graduate courses~~ and receive letter grades in most departments. ~~See department descriptions for specific information.~~ Once this maximum of *6 credits* is reached, additional course registrations will be changed to pass/fail and *will* not be used for degree credit.
The fact that a student has been allowed to register for graduate courses (and earn credit) does not guarantee that the student will be admitted to that department's certificate or degree program at a later date. Students are therefore encouraged to apply for admission to a degree or certificate program prior to any course registration.

Impact on Degree Requirements: This motion will not impact degree requirements.

Resources and Anticipated Instructors: No new resources needed

Implementation Date: Implementation date for this action is the 2021-2022 academic year.

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Marsha Rolle, Chair)
Re: Motion to approve revisions to an existing graduate program, **MSMG**. This motion was approved by the Foisie Business School on Nov 11, 2020.

Motion: The Committee on Graduate Studies and Research recommends, and I move that the existing graduate program, Master of Management (MSMG), be revised, as described below.

Summary: (*Overview of what is being proposed and why.)*
This motion proposes a revision to the FBS MSMG program. The MSMG provides an introduction to the business functions and business leadership to those with little or no work experience. It is based on the core courses in our MBA curriculum. Because the MBA program is being revised, we must revise the MSMG to maintain consistency and at the same time a clear differentiation between the two programs.

We propose to change FBS's MSMG program as follows:

- No change to the total credits required. The current program is 30 credits (Ten 3-credit courses)
- Change from 7 required courses and 3 electives to 8 required courses and 2 electives. The proposed change involves updating the required courses to align more directly with the revised MBA program. The electives may be taken from or outside FBS.

The revised program is comprised of existing FBS graduate courses, with no revisions to these courses. This revision involves re-structuring and updating the overall program, with no need for additional courses and no need for new resources.

Proposed Modifications to Graduate Catalog:
(ALL relevant sections to be added to the graduate catalog should be included. Remember, the graduate catalog is a contract with our students. Specifically, the following should be addressed:)

Program Goals and Objectives:
Current Catalog version:
The MSMG offers students a flexible yet focused program that will improve business skills while excelling in technology-based organizations. The MSMG also provides a compelling pathway to an MBA, recognizing the value of work experience. Upon earning the MSMG, and after 2 – 6 years of professional experience, students may return to WPI to complete the requirements for an MBA with just 27 additional credits, including the hallmark project experience of WPI (MBA admission required).

New Catalog version:
WPI's MSMG program is aimed at fresh undergraduates with little or no industry experience, who are seeking to complement the skills they developed, as undergraduates in any major, with business and leadership skills. It is frequently chosen by WPI undergraduate students in any major as their

MS choice for a BS/MS. The curriculum features foundational courses from cross-functional business disciplines and courses that inculcate leadership and team skills.

- Gain foundational knowledge of key business functions such as finance, marketing, information technology, and operations management.
- Develop evidence-based problem solving, leadership, and team skills in an environment that fosters the intersection of theory and practice.

Admissions Requirements:
The admission requirements remain the same as currently stated in the graduate catalog as updated on MSMG webpage, which are:

- Applicants should have the analytic aptitude and academic preparation necessary to complete a technology-oriented business program. This includes a minimum of three semesters of college level math or two semesters of college level calculus.
- Applicants must have earned the equivalent of a four-year U.S. bachelor's degree to be considered for admission.
- GMAT or GRE is not required currently due to the pandemic.

Faculty Contacts: Purvi Shah, Diane Strong.

Requirements for the Master of Management (MSMG) – 30 credits:
The MSMG is designed as a foundational master's degree to gain general business and management skills. As such, it does not provide any capstone project or options related to a research degree (e.g., no provision for research credits, qualifying exams, a thesis option, or research seminars).

Notes on Delivery mode: This program involves hybrid delivery with some courses offered on-campus, but others only online.

Requirement 1: MSMG students must complete eight required courses that introduce them to foundational areas of general management as follows:

1. BUS 500 Business Law, Ethics, and Social Responsibility
2. ETR 593 Technology Commercialization
3. FIN 500 Financial Management
4. MIS 584 Business Intelligence
5. MKT 500 Marketing Strategy
6. OBC 505 Teaming and Organizing for Innovation
7. OBC 506 Leadership
8. OIE 501 Operations Management

Requirement 2: MSMG students must complete two electives, which may be taken outside FBS.

- All FBS graduate courses qualify as electives.
- Students with little or no business background are encouraged to select their electives as additional business cross-functional courses based on their interests.
- WPI undergraduate students taking the MSMG as the MS component of a BS/MS degree option may use senior-level BS science or engineering courses that are allowed to count as graduate elective courses.

New Course Descriptions:
No new courses are being proposed.

Revised Course Descriptions (and Titles) for Existing Courses
As part of this proposal, we are updating the course title for one core course in the MSMG program.

ETR 593 – Revise Course Title Only
Current title and description
ETR 593. Technology Commercialization: Theory, Strategy and Practice (3 credits)

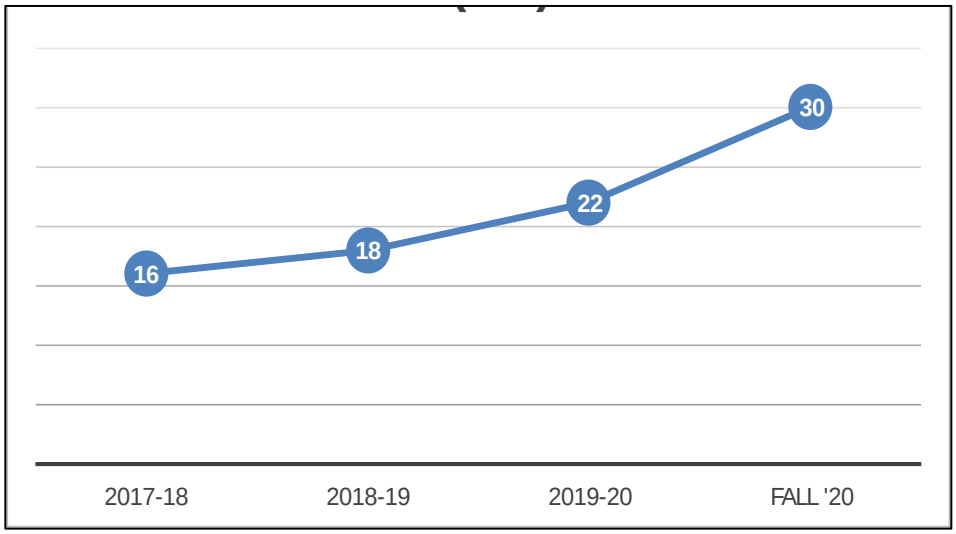
In the modern world of global competition the ability to utilize technological innovation is increasingly important. This course will examine the sources of new technology, the tools to evaluate new technologies, the process of intellectual property transfer, and the eventual positioning of the resultant products and services in the commercial market. Its purpose is to improve the probability of success of this discipline in both existing organizational models and early stage ventures. Specific cases studies of successful technology commercialization processes will be used to supplement the course materials.

Revised (Title only)
ETR 593. Technology Commercialization (3 credits)

In the modern world of global competition the ability to utilize technological innovation is increasingly important. This course will examine the sources of new technology, the tools to evaluate new technologies, the process of intellectual property transfer, and the eventual positioning of the resultant products and services in the commercial market. Its purpose is to improve the probability of success of this discipline in both existing organizational models and early stage ventures. Specific cases studies of successful technology commercialization processes will be used to supplement the course materials.

Rationale: *(Explain the need for the degree or program, and the value of offering it.)*
The proposed change is a minor revision to the MSMG program so that it is consistent with the revised FBS MBA program. FBS has offered an MSMG program modeled on its MBA program, but designed for those without work experience and with WPI BS/MS students in mind.

Opportunity and Market Analysis: *(An assessment of the need for the program and potential student interest.)*
Current market developments are driving continued interest in a business program that provides the core elements of a traditional business program to students with undergraduate degrees and no industry experience. The use of the MSMG as a BS/MS option for WPI science and engineering majors is growing as can be seen by the trend of an increasing number of new BS/MSMG students in the chart below.



Comparison to Existing Programs at WPI:
This motion is a revision of our current MSMG program. It maintains the same quality and rigor of the current MSMG degree.

Impact on Existing Programs at WPI:
We expect no impact on existing programs at WPI.

Comparable Programs at other Universities: (if relevant)
Implementation:
Program Management
This program is the responsibility of our Interdisciplinary Policy and Curriculum Committee (IPCC), that manages the MBA and MSMG programs, current chair Professor Purvi Shah. Changes to the program, student petitions, etc. will all go through this committee. Operationally, the FBS faculty are responsible for program delivery and the FBS program staff are responsible for program management.

Implementation Date

Targeted start for implementation is Fall 2021.

Transition Plans

Since the changes are minor, transitioning current students to the new version of the program is relatively easy. The FBS program staff will create revised plans for students currently enrolled in the program who are not graduating before the transition to the new program.

Resources Required:

No new resources are required because there are no new courses.

COMMITTEE BUSINESS

1. Motion to establish Department of Integrative and Global Studies
2. Proposal for the Department of Integrative and Global studies (DIGS)
3. Motion for MS program in Community Climate Adaptation (MS-CAA)
4. Motion for BS/MS program in Community Climate Adaptation
5. Motion to approve IGS course prefix
6. Motions to approve new courses in DIGS
7. Motion to establish a new Master of Science program in Cybersecurity (MS-SEC)
8. Motion to establish a new Master in Computer Science program (MCS)
9. Motions to approve new CS courses

Date: December 10, 2020
To: WPI Faculty
From: Committee on Governance (Prof. Boudreau, Chair)
Re: Establish the Department of Integrative and Global Studies in the Global School

Motion: The Committee on Governance recommends, and I move, that the WPI faculty endorse the Administration's proposal to create the Department of Integrative and Global Studies (DIGS) within the Global School at WPI.

Rationale: There is a clear logic to have an academic department, the DIGS, within the Global School. Departments are the basic organizational units at WPI for supporting the faculty and staff responsible for administering academic programs and research. In the past, the IGSD functioned as a department in many respects, with the Faculty Handbook including specific provisions for the IGSD Dean to perform responsibilities otherwise expected of department heads, in support of the faculty who reported only through the IGSD. Similarly, the core GPS faculty were also supported through a non-departmental structure, with the Associate Dean of Undergraduate Studies serving some of the functions of a department head. However, as we go forward under the Global School umbrella and merge IGSD faculty with GPS faculty, it simply makes sense to constitute an academic department that houses the 27 faculty and 3 associated staff. Departments provide structure, accountability and safeguards that are underdeveloped in the current structure. Furthermore, as we create new degree programs and courses, hire more tenure track faculty with research expectations, and write grants to collaborate across WPI and the wider community, a departmental structure can better support the development of the faculty and the academic programming. Formalizing the DIGS as a department is essential now to sustaining existing programs and people and providing a solid foundation for future growth. Importantly, faculty in DIGS will maintain their affiliations, relationships and responsibilities with other departments.

Background: In May 2019, the WPI faculty, administration and Board of Trustees created the institution's fourth school, the Global School. This proposal is to create an academic department within the Global School, the Department of Integrative and Global Studies (DIGS), comprising the faculty and academic staff and administrators formerly constituting the core IGSD and GPS faculty, who do not report through any other academic department. As a department, we are uniquely positioned and trained to see the connections across disciplines, engage in scholarship and teaching around sociocultural and sociotechnical issues, and facilitate the development of students and research partnerships that address our most entrenched grand challenges.

The Department of Integrative and Global Studies Defined: In choosing this name, the department is situating itself within the academic landscape in a way that signals a core philosophy and methodological practice, and a broad thematic area of learning, research, and application that describes much of what we do now and envision for the future. As defined by the AAC&U[1] "Integrative and applied learning is an understanding and a disposition that a student builds across the curriculum and co-curriculum, from making simple connections among ideas and experiences to synthesizing and transferring learning to new, complex situations within and beyond the campus." Integrative learning thus requires learning from many sources, fields and

[1] https://www.aacu.org/value/rubrics/integrative-learning

across disciplines in a manner that allows practical application for solving problems. It is closely aligned with the 'Theory and Practice' motto of WPI. This sensibility and related teaching strategies are at the heart of the key programs the DIGS faculty contribute to - the IQP and GPS, as well as to the pending graduate program in Community Climate Adaptation.

"Global Studies" meanwhile is an emerging umbrella for the kind of transdisciplinary work that we do and is increasingly valued in higher education. Global Studies addresses the challenges and opportunities associated with global:local processes (social, ecological, economic, political, cultural, technological). The field is diverse, but concerned with both "local" and "global" dynamics and the ways that agents, from individuals to large multinational systems, can play a role in addressing those issues. The faculty who belong to this department have expertise that collectively spans the much of the range of issues and topics encompassed in the broad category of Global Studies.

Academic programming: The core programs that are housed in the Global School, the IQP, the Global Projects Program and the Great Problems Seminars, are campus-wide collaborations. It is important to recognize the essential contributions of faculty from across the university, and vital that all WPI faculty have the opportunity to participate in and benefit from these programs. While the GPS and GPP are programs of the entire institution, the DIGS faculty will continue to serve as the stable intellectual and programmatic backbone of these programs. DIGS faculty have been significant contributors to these programs and are excited by the opportunities provided by linking the two programs. Further, they see real opportunities in a programmatic trajectory that starts students with a Great Problems seminar, leading to an IQP and beyond to the CGSR-approved graduate program in Community Climate Adaptation.

WPI offers students the opportunity to design their own interdisciplinary majors, and the IGSD was responsible for approving and supporting these students. This activity is more appropriately done through an academic department and DIGS will take on this responsibility. Though the number of students who avail themselves of this option is small (0-2 graduates annually, six currently in the pipeline), DIGS will take on the roles specified in the catalog of approving and overseeing the completion of these degrees.

We have approval from CGSR for a Community Climate Adaptation (CCA) Master's program that builds on WPI's distinctive interdisciplinary, project-based approach giving students training to support communities and organizations as they adapt to the impacts of a changing climate. Through this joint program with the Department of Civil and Environmental Engineering, students can follow an MS or BS/MS track and gain collaborative and comparative perspectives on climate adaptation strategies. Among other elements, the CCA program offers graduate students a deep, thematically-informed opportunity for a GPP Graduate Qualifying Project experience leveraging our project center network.

Research: DIGS faculty, while predominantly teaching-track faculty, have an impressive record of scholarship and applied research projects (over 80 publications in the past 5 years and more than $3M in grant funding in that same time frame). We work on research projects that span the range of global grand challenges, addressing topics from environmental sustainability and social justice in cities, to water resources, risk, governance, and climate adaptation; from energy policies and transitions, to health, human rights, and community engagement with technology to support our vulnerable local and global neighbors. The new department is designed to better

support, deepen, and share the value of these contributions and related scholarly efforts, including collaborative efforts with academic and non-academic partners.

Administration

Dean: The dean of the Global School will have all the same responsibilities of deans of our other schools (strategic planning, fundraising, external relations, support and development of programs, etc.). In addition, the Global School dean will be charged with negotiating new international MOUs and current commitments to our international partners (e.g., Global Center for Public Safety). Oversight of the Global Experiences Office and its role of supporting ALL international travel of campus entities (athletics, Engineers without Borders, music groups, GPP-participating students and faculty, etc.) is another unique and major responsibility. The Global Lab will also be under the dean's supervision. With the growth of GPP to 95% of the current junior class, and the continued reliance on faculty from across WPI, one new key responsibility of the dean will be to work with peer deans to allocate resources to support schools and departments that contribute faculty time to our key programs.

Associate Dean: This position will fulfill functions long associated with the Dean of the IGSD, primarily overseeing academic and logistical support functions (recruiting faculty advisers, organizing the Global Fair, setting schedules, managing project center capacity to meet Global Projects for All, identifying new project center opportunities, identifying and mentoring center directors, hiring the up to 15-20 adjuncts required to fully staff the GPP, etc.) of the Global Projects Program including the HUA and MQP centers, and supporting the success of the IQP on and off campus. With the growth of the GPP, this is now a full-time function.

Department Head: The department head will be the academic leader of the department and attend to responsibilities set forth in the Faculty Handbook (e.g., supervising faculty searches, providing support and guidance for faculty and programmatic development, conducting annual reviews, salary recommendations, tenure and promotion nominations, heading departmental tenure committees), with oversight of the academic programs of the department.

Faculty: DIGS Faculty are those faculty who were hired into IGSD, or as core GPS faculty, or into the Global School directly. Currently there are 26 full time faculty members and one in phased retirement. Twenty-one of these are TRT teaching professors and six are TTT, at all levels (assistant, associate, full). DIGS Faculty formerly in IGSD have teaching responsibilities primarily in the GPP, though have contributed to teaching courses in the Global Public Health program, the Environmental and Sustainability Studies program, and SSPS. Five of the core GPS faculty, in addition to teaching GPS courses, have affiliate appointments and teach in other departments (BBT, SSPS, CEE, HUA); the other 22 have no academic home outside of this unit. Because the Global School is predicated on the idea of providing faculty a wide variety of ways to be formally affiliated with the school, we anticipate additional roles for faculty who have a home department in other schools across campus, but would like an affiliation with the Global School.

Departmental Staff: The faculty in the department are supported by three staff members: our administrative assistant who welcomes students to the Global Program and supports them and faculty in a variety of ways; our Director of Human Subjects Research and Academic Programs; and our Operations Manager for budget planning, oversight and expenses.

Resources Required

The Department of Integrative and Global Studies will require only modest net additional resources because almost all personnel and programming are in place already. The dean has already been budgeted and the search is ongoing. The associate dean position is also already in place.

Department Head: ***New*** Department Head to be hired following the procedures in the Faculty Handbook.

Faculty: There will be 26 full-time faculty in DIGS, one additional in year one of phased retirement. The administration demonstrated its support of this department by the addition of two tenure-track faculty and one tenured professor in July 2019. DIGS will be requesting tenure-track hires to replace two TRT faculty who chose to retire this past summer. Additional faculty requests will be made through APBP as needed.

Office Space: While there is significant, ongoing inadequacy of departmental office space for faculty and staff (despite extensive sharing of offices term-by-term as temporary vacancies arise due to faculty travel), we have been assured that space will become available in the Project Center once the CDC moves into the new academic building.

Proposal to Create
The Department of Integrative and Global Studies

Submitted to COG
October 20, 2020

Introduction

In May 2019, the WPI faculty, administration and Board of Trustees created the institution's fourth school, the Global School. This proposal is to create an academic department within the Global School, the Department of Integrative and Global Studies (DIGS), comprising the nearly 30 faculty and academic staff and administrators formerly constituting the core IGSD and GPS faculty, who do not report through any other academic department. As a department, we are uniquely positioned and trained to see the connections across disciplines, engage in scholarship and teaching around sociocultural and sociotechnical issues, and facilitate the development of students and research partnerships that address our most entrenched grand challenges.

Summary

Rationale: There is a clear logic to have an academic department, the DIGS, within the Global School. Departments are the basic organizational units at WPI for supporting the faculty and staff responsible for administering academic programs and research. In the past, the IGSD functioned as a department in many respects, with the Faculty Handbook including specific provisions for the IGSD Dean to perform responsibilities otherwise expected of department heads, in support of the faculty who reported only through the IGSD. Similarly, the core GPS faculty were also supported through a non-departmental structure, with the Associate Dean of Undergraduate Studies serving some of the functions of a department head. However, as we go forward under the Global School umbrella and merge IGSD faculty with GPS faculty, it simply makes sense to constitute an academic department that houses the 27 faculty and associated staff. Departments provide structure, accountability and safeguards that are underdeveloped in the current structure. For example, faculty in the GPS and IGSD have no official opportunity to evaluate their supervisor, unlike faculty within departments, who do so during the 2nd and 4th year evaluation of department heads. This seems especially important for the faculty in the Global School, as they are largely teaching faculty and few have the security of tenure. Further, as we create new degree programs and courses, hire more tenure track faculty with research expectations, and write grants to collaborate across WPI and the wider community, a departmental structure can better support the development of the faculty and the academic programming. Importantly, faculty in DIGS will maintain their affiliations, relationships and responsibilities with other departments.

Academic programming: The core programs that are housed in the Global School, the IQP, the Global Projects Program and the Great Problems Seminars, are campus-wide collaborations. It is important to recognize the essential contributions of faculty from across the university, and vital that all WPI faculty have the opportunity to participate in and benefit from these programs. DIGS faculty will continue to provide the stable intellectual and programmatic backbone for the IQP and GPS.

The DIGS will also support individually designed, interdisciplinary undergraduate degrees, and a graduate program in Community Climate Adaptation, joint with Civil and Environmental Engineering (approved by CGSR). Currently, interdisciplinary (individually designed) majors are overseen by the IGSD and its dean. These majors are more appropriately administered by an academic department. We expect to continue to develop new and expanded academic programs in the coming years, both internally and with other departments, which will be submitted to the appropriate faculty governance committees for approval.

Research: DIGS faculty, while predominantly teaching-track faculty, have an impressive record of scholarship and applied research projects (see Appendix 1). We work on research projects

with immediate and timely importance that span the range of global grand challenges, addressing topics from environmental sustainability and social justice in cities, to water resources, risk, governance, and climate adaptation; from energy policies and transitions, to health, human rights, and community engagement with technology to support our most vulnerable local and global neighbors. For many DIGS faculty, the expertise and integrative learning strategies we bring to students and external partners on global:local projects in the GPP and GPS also underpin our research contributions. The new department is designed to better support, deepen, and share the value of these contributions and related scholarly efforts, including collaborative efforts with academic and non-academic partners.

This proposal is supported by the DIGS faculty, the Global School Implementation Committee, and the Provost.

Rationale

The DIGS is foundational to the new Global School, providing the institutional structure, core academic programs, and research infrastructure upon which much, though not all, of the academic enterprise of the Global School will be constructed, especially in the next few years. The department has a clear mission and its faculty and staff already enjoy a record of successful program delivery.

An Institutional Necessity: As noted, the IGSD and GPS are now a combined faculty under the Global School and formalizing a departmental structure will bring these 27 faculty and programs into accord with the basic way WPI organizes academic activities. As the programs grow, and we add new ones, a department structure assists with recruiting, retaining, and supporting the development of the best faculty.

The Department of Integrative and Global Studies Defined: In choosing this name, the department is situating itself within the academic landscape in a way that signals a core philosophy and methodological practice, and a broad thematic area of learning, research, and application that describes much of what we do now and envision for the future. As defined by the AAC&U[2] "Integrative and applied learning is an understanding and a disposition that a student builds across the curriculum and co-curriculum, from making simple connections among ideas and experiences to synthesizing and transferring learning to new, complex situations within and beyond the campus." Integrative learning thus requires learning from many sources, fields and across disciplines in a manner that allows practical application for solving problems. It is closely aligned with the 'Theory and Practice' motto of WPI. This sensibility and related teaching strategies are at the heart of both the IQP and GPS, as well as to the pending graduate program in Community Climate Adaptation.

It is critical to understand that integrative learning is not just the realm of general education. Rather, peer and aspirational institutions such as MIT, RPI, and Case Western have developed programs whereby students set a focused concentration and bring in necessary classes to ensure that they have a holistic interdisciplinary experience. For DIGS, the markers of research and degrees proposed should have a strong socio-technical understanding, address grand challenges, and be global in focus while local in practice.

[2] https://www.aacu.org/value/rubrics/integrative-learning

"Global Studies" meanwhile is an emerging umbrella for the kind of transdisciplinary work that we do and is increasingly valued in higher education. Global Studies addresses the challenges and opportunities associated with global:local processes (social, ecological, economic, political, cultural, technological). The field is diverse, but concerned with both "local" and "global" dynamics and the ways that agents, from individuals to large multinational systems, can play a role in addressing those issues. The faculty who belong to this department have expertise that collectively spans the much of the range of issues and topics encompassed in the broad category of Global Studies. The value of integrative learning and global studies at WPI is underscored by the contribution of the GPP and GPS to WPI's identity, institutional learning outcomes, accreditation processes, and overall student development and satisfaction.

Distinguishing Aspects of Department: External

A scan of departments and programs operating within the space of Integrative and Global Studies suggests:

- While there are a few departments of either Integrative Studies (U. South Alabama, George Mason has a School of Integrative Studies), or Global Studies (Providence College, UC Santa Barbara), there are many more programs within universities that focus on one or the other: global studies (Brandeis University, UC Berkeley, Northeastern) or integrative studies (Michigan State University, Seattle University, U Alabama). The University of Nebraska recently announced a new School of Global Integrative Studies. Our DIGS, therefore, will become one of several programs across the nation delivering educational programming in these areas. We will be distinguished from many of these by our solutions orientation and the advantages that our STEM expertise and networks afford; many similar programs are largely policy or economics focused.
- The core issues the department deals with – Grand and other Challenges in diverse local contexts; robust local partnerships and collaborative strategies across public, private, non-profit, academic and community sectors; attention to social, environmental, technological, and cultural dimensions of global and local change; strategies for project-based and action-oriented learning – are all socially relevant and at the forefront of efforts to re-envision the academic enterprise. As our programs grow, we anticipate competing in the Times Higher Ed UN Sustainable Development Goals university rankings.
- Awards and recognition: The Global Projects Program is a widely recognized centerpiece of WPI's identity and student and faculty recruitment efforts. WPI was ranked No. 1 by the Princeton Review in 2016 for its study abroad program . The GPP and GPS programs, and their leadership, played a pivotal role in securing for WPI the National Academy of Engineering's 2016 Bernard M. Gordon Prize for Innovation in Engineering and Technology Education, and was recognized by the National Academy of Engineering as a Real World Engineering Education program in 2012.
- Professional Legitimacy and Network Building: By establishing an academic department, too, we become a structural entity able to join professional societies such as the Global Studies Research Network or Global Studies Association. We can also enter into research and program partnerships with multinational organizations like the United Nations, who are increasingly partnering with universities to address global challenges, thus allowing opportunities such as gaining Observer status to bring students to COP26 or other international climate events.

Distinguishing Aspects of Department: Internal

DIGS faculty and staff have been and will continue to be central to the IQP and GPS, two large and iconic academic programs that are intensely interdisciplinary and involve faculty and others

from across campus. While these Global School programs, currently and in the future, rely on contributions from many WPI departments, the DIGS faculty and staff will continue to play an especially committed role in fostering their development. In fact, the DIGS faculty designed, executed and continue to refine the academic preparation for the Global Projects Program, Social Science Research Methods for the IQP, ID 2050. Similarly, they have been central to the development of key programmatic aspects of the GPS. As noted below, we have distinctive strengths in teaching, research and "impact" that serve these WPI core programs particularly well. Further, a master's program proposed by DIGS faculty in collaboration with CEE (see more below) has been approved by CGSR.

Contributions to WPI Strategic Planning and Goal Attainment: The IGSD played an important role in conceptualizing and accomplishing core elements of WPI's last strategic plan, "Elevate Impact." The *Global Projects for All* goal was met by raising GPP participation by almost 400 students annually in just four years, a 55% increase. With partners from across campus, we also continued to innovate and streamline operations in a variety of ways: a new GPP application and project center admission process (the Global Opportunities Application Tool - GOAT matching tool); helped envision and launch E-Projects 2.0; introduced the Global Projects Scholarship; developed new approaches to project reporting; opened new project centers and expanded terms at others; and managed significant stress that comes with welcome, but challenging, program growth. GPS faculty have developed new global project centers, including the Paraguay Project Center and the Paxton Farm Stay Project Center. The latter aims to support *Global Projects for All*, by offering off-campus residential IQPs for groups of students who often cannot go abroad: ROTC, transfer students, those with jobs, health issues, etc.

A Department within the Global School: A distinguishing feature of the Global School is the high priority placed on "porous boundaries" and intensive collaboration with departments, programs, faculty and staff across campus. Other activities are being proposed under the Global School that may lie partially or entirely outside the department, including new graduate-level programs proposed by departments in other schools. The DIGS is participating in the new IDEaS graduate program, and we expect that both the school and the department will be shaped by the evolution of other curricular and research programs over time. **Formalizing the DIGS as a department is essential now to sustaining existing programs and people and providing a solid foundation for future growth. We expect to continue to be flexible, collaborative, inventive, and efficient in growing the department and the school.**

Disadvantages of Status Quo: While thriving, the IGSD and GPS programs and faculty have lived with significant institutional uncertainty for over two years as discussions about the Global School have advanced. Through the formation of a traditional department, we can better adhere to language and processes outlined in the faculty handbook, streamline decision-making to not have "exceptions" for a division, and better cohere with the faculty governance structure of WPI. With core programs to sustain and new programs to develop, a large combined and expanding faculty that includes new TTT and TRT faculty, and significant contributions to be made in launching the Global School, it is vital that we create the DIGS to regularize the administration and identity of this group within WPI's normal departmental structure.

Academic Programming

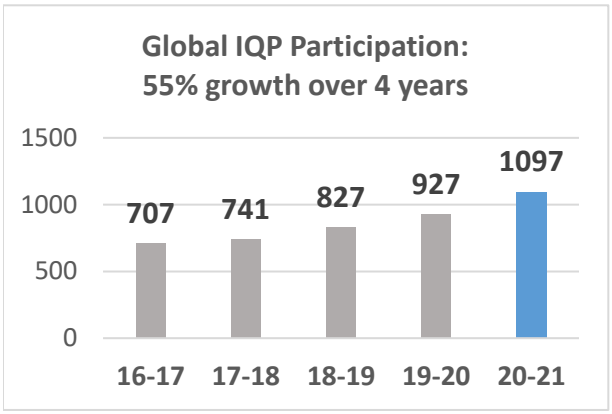
While the GPS and GPP are programs of the entire institution, with faculty from across the university contributing to both, the DIGS faculty will continue to serve as the stable intellectual and programmatic backbone of these programs. DIGS faculty have been significant contributors

to the development of these programs and are excited by the opportunities provided by linking the two programs. Further, they see real opportunities in a programmatic trajectory that starts students with a Great Problems seminar, leading to an IQP and on beyond to the CGSR-approved graduate program in Community Climate Adaptation.

Global Projects Program (GPP)

The Global Projects Program, particularly the off-campus IQP, has grown to include several distinct elements that offer students significant opportunities for integrative and applied learning. As the program has grown dramatically in the past five years, the DIGS faculty contributions have been crucial. They teach nearly all the IQP prep courses (ID2050) and comprise 40% of Center Directors and more than 50% of Center Advisors. They produce materials available to all IQP advisors, serve as resources to new IQP center directors and advisors, and contribute to routine assessment of the program. They will continue to contribute to the intellectual development and assessment of the IQP program as well as mentoring of participating non-DIGS faculty. Their role is essential to the continued growth, improvement, and functioning of this campus-wide program.

Figure 1 Global Projects Program Growth 2016-17 to 2020-21



Great Problems Seminar (GPS)

As with the IQP, the GPS program provides an exemplary integrative and applied learning experience for WPI students. Established in 2007, the program gives students and faculty the opportunity to combine disciplinary lenses to explore holistic approaches to global problem solving. While projects are typically used as culminating or capstone activities, the GPS program has demonstrated that projects can be valuable as an entryway into college learning. Extensive assessment of the program has shown that it provides students with a richer, intentional first college experience, creates early opportunities for student internships, improves student motivation, and provides preparation for subsequent projects and coursework. In doing so, it builds student confidence.

Over the past 5 years, the GPS has enrolled over 250 first year students annually (Table 1). Faculty recruitment and technology challenges have led to some variation in the numbers of students enrolled. However, recent changes to GPS scheduling resulted in a sizable uptick in enrollments for the current year, suggesting we will continue to be able to support a significant fraction of the class in this distinctive educational element. The students come from all majors, though they cluster in topics related to their interests, e.g. pre-health majors are more prevalent in Heal the World, engineering majors are more prevalent in Shelter the World and Power the World.

Table 1. Annual GPS Enrollments

Year	Pop
2017	259
2018	313
2019	277
2020	259
2021	362

Similar to the IQP, the Great Problems Seminar program relies on the involvement of faculty from across WPI. Faculty from engineering departments (e.g. Apelian, DiBiasio, Farzin, Mishra, Savilonis), Arts and Sciences (e.g. Boudreau, Beck, Eddy, Johnson, Medich, Rao) and Business (Vassallo, Wulf), have all contributed over the years, with 10 non-DIGS faculty involved in the current academic year. The program will continue to need and welcome faculty from across campus to the program. The DIGS faculty will continue to provide essential leadership, programmatic development, and assessment to continually improve the program.

Individually Designed Interdisciplinary Majors

WPI offers students the opportunity to design their own interdisciplinary majors, and the IGSD was responsible for approving and supporting these students. This activity is more appropriately done through an academic department and DIGS will take on this responsibility. Though the number of students who avail themselves of this option is small (0-2 graduates annually, six currently in the pipeline), DIGS will take on the roles specified in the catalog of approving and overseeing the completion of these degrees.

Proposed Academic Program Development

We have approval from CGSR for a Community Climate Adaptation (CCA) Master's program that builds on WPI's distinctive interdisciplinary, project-based approach giving students training to support communities and organizations as they adapt to the impacts of a changing climate around the globe. Through this joint program with the Department of Civil and Environmental Engineering, students can follow an MS or BS/MS track and gain collaborative and comparative perspectives on climate adaptation strategies. Among other elements, the CCA program offers graduate students a deep, thematically-informed opportunity for a GPP Graduate Qualifying Project experience leveraging our project center network.

The program structure we have used for CCA is designed to serve as a model that could be extended to other themes and partnerships across campus in the context of an adaptable framework that builds upon our strengths as a department and university, bringing integrative, project-based, impacts-oriented educational opportunities to graduate students. This flexibility will allow us in the future to award master's and doctoral degrees in Integrative and Global Studies, with concentrations in specific topical and/or geographical areas, and with various partnering departments.

We are also in active discussions with faculty from other departments who are advancing efforts to develop degree programs under the Global School umbrella. This proposal supports cross-departmental collaboration by in fact bringing DIGS faculty and staff into a normal departmental structure. We further envision, though are not proposing at this time, the development of signature undergraduate degree programs that capitalize on our expertise in geography, environmental issues, social structures and technologies as well as our unique experiential, integrative programs and approach to learning.

Research and Application

As is necessary for a Department of Integrative and Global Studies, the DIGS faculty come from a diverse range of scholarly backgrounds, largely from the social sciences and humanities, but extending also to the sciences and engineering. The department creates strength from this diversity through research interests that converge on the goal of addressing today's most pressing problems and global challenges. We've identified four areas of current and potential research program development: Social and Technological Systems Responding to Climate Change;

Participatory Sustainable Community Development; Social and Technological Systems for Food and Water Resources Management; and Experiential/Project-Based Learning Programs.
While all but 6 current DIGS faculty are Teaching/Research Track (TRT) faculty, we nonetheless have been very active in research and scholarship, and in the application of insights gained to challenges around the world and in our own backyard. Our faculty publish widely, including in top tier disciplinary, interdisciplinary and education-focused journals, and participate actively in conferences and workshops, professional associations, funding review panels, and other aspects of research and scholarship communities, often in a leadership capacity and with awards and other recognition attesting to the quality of these contributions (see publications and funding in Appendix 1). We are excited at the prospect of becoming an academic department and the increasing prospects for collaborative research efforts. Below, we have delineated the key topics of research interest and the faculty who contribute in these areas.
Social and Technological Systems Responding to Climate Change (Marja Bakermans, Melissa Belz, John-Michael Davis, Leslie Dodson, Joe Doiron, Katherine Foo, Steve McCauley, Geoff Pfeifer, Derren Rosbach, Ingrid Shockey, Sarah Stanlick, Lisa Stoddard, Sarah Strauss, Seth Tuler)

- Climate adaptation and mitigation
- Climate justice and equity
- Citizen science in documenting urban and environmental change
- Agriculture's role in climate change and climate mitigation; climate resilient agriculture
- Differential vulnerability to climate change; vulnerability assessment; community resilience
- Public participation in decision making with regard to urban climate adaptation and facility siting
- Water resource management and energy transitions

Participatory Sustainable Community Development (Melissa Belz, Fabio Carrera, Katherine Foo, Robert Hersh, Courtney Kurlanska, Steve McCauley, Geoff Pfeifer, Derren Rosbach, Sarah Stanlick, Seth Tuler)

- Governance of urban spaces, livable cities and social justice
- Green infrastructure in cities esp. with regard to equity of environmental services
- Democracy in policy processes (public participation), implications of authoritarianism
- Green city initiatives and sustainable urban infrastructure
- Urban and regional planning
- Role of public interest technology in promoting community wellbeing (health, poverty alleviation, education, etc.)
- Sustainable development – community scale and micro-enterprises

Social and Technological Systems for Food, Water, and Energy Resources Management (Marja Bakermans, Melissa Belz, Corey Dehner, Leslie Dodson, Robert Hersh, Derren Rosbach, Lisa Stoddard, Sarah Strauss)

- Political, economic and environmental change as impacting small agricultural producers and food security especially in developing countries
- Urban agriculture and appropriate technology for small producers
- Agroecology

- Public and environmental health impacts of industrial livestock production
- Food production, environmental racism, and environmental justice
- Energy transitions and cultures of energy
- Forest management for water, food, and carbon

Experiential/Project-based Learning Programs (Marja Bakermans, Melissa Belz, Leslie Dodson, Joe Doiron, Courtney Kurlanska, Steve McCauley, Geoff Pfeifer, Lisa Stoddard, Sarah Stanlick, Rob Traver, Rick Vaz, Kris Wobbe)

- Integrating sustainability studies into experiential learning
- Using peer mentors to advance globally engaged students
- Alternative pedagogies and action learning in higher education
- Bias and stereotyping on student teams
- Project and problem-based learning
- High impact learning practices
- Integrating STEM and social justice in course curriculum

Funding opportunities: Because of the interdisciplinary nature of our work, DIGS faculty have been able to successfully apply for funding from a broad range of sources (see Appendix 1): traditional STEM funding (NSF, NOAA), foundations (Davis Educational Foundation, Campus Compact, Bringing Theory to Practice, Aspen Institute) and international funding opportunities (USAID, Swedish International Development Agency). As we consider what is next for the Global School and the impact that it can make, we have identified foundation, governmental, private sector partnerships, alumni engagement, and places where the capital campaign can leverage the potential of this new department to deepen our commitment and reputation in convergence research and grand challenge innovation. Our funding requests will be strengthened by the clear administrative and institutional affirmation a department can provide.

Administration

As the Global School has a more complex structure than the others, we will lay out the key roles of the different administrators.

Dean: The dean of the Global School will have all the same responsibilities of deans of our other schools (strategic planning, fundraising, external relations, support and development of programs, etc.). In addition, the Global School dean will be charged with negotiating new international MOUs and current commitments to our international partners (Global Center for Public Safety). Oversight of the GEO and its role of supporting ALL international travel of campus entities (athletics, Engineers without Borders, music groups, GPP-participating students and faculty, etc.) is another unique and major responsibility. The Global Lab will also be under the dean's supervision. WIth the growth of GPP to 95% of the current junior class, and the continued reliance on faculty from across WPI, one new key responsibility of the dean will be to work with peer deans to allocate resources to support schools and departments that contribute faculty time to our key programs.

Associate Dean: This position will fulfill functions long associated with the Dean of the IGSD, primarily overseeing academic and logistical support functions (recruiting faculty advisers, organizing the Global Fair, setting schedules, managing project center capacity to meet Global Projects for All, identifying new project center opportunities, identifying and mentoring center directors, hiring the up to 15-20 adjuncts required to fully staff the GPP, etc.) of the Global

Projects Program including the HUA and MQP centers, and supporting the success of the IQP on and off campus. With the growth of the GPP, this is now a full-time function.
Department Head: The department head will be the academic leader of the department and attend to responsibilities set forth in the Faculty Handbook (e.g., supervising faculty searches, providing support and guidance for faculty and programmatic development, conducting annual reviews, salary recommendations, tenure and promotion nominations, heading departmental tenure committees), with oversight of the academic programs of the department.
Faculty: DIGS Faculty are those faculty who were hired into IGSD, or as core GPS faculty, or into the Global School directly. Currently there are 26 full time faculty members and one in phased retirement. Twenty-one of these are TRT teaching professors and six are TTT, at all levels (assistant, associate, full). DIGS Faculty formerly in IGSD have teaching responsibilities primarily in the GPP, though have contributed to teaching courses in the Global Public Health program, the Environmental and Sustainability Studies program, and SSPS. Five of the core GPS faculty, in addition to teaching GPS courses, have affiliate appointments and teach in other departments (BBT, SSPS, CEE, HUA); the other 22 have no academic home outside of this unit. The list of full-time faculty is included in Appendix 1, along with their recent publications and funding. The sustained commitment and identification of faculty with these programs has underpinned programmatic success and been valued by faculty and administration alike, and thus a goal in creating the new school and department has been to maintain these commitments while also allowing additional flexibility for teaching in other programs. New hires into the department may have responsibilities that vary with expertise and needs across the existing and new programs. New hires may also have joint appointments with other departments. Faculty in the department will be expected to participate on committees that oversee the academic programs as in other departments.
In addition to the permanent, full-time faculty there are a large number of adjuncts hired to teach ID2050 and advise off-campus projects; this year there are 17 courses being taught by adjunct faculty and another 15 adjunct project center advisors.
Because the Global School is predicated on the idea of providing faculty a wide variety of ways to be formally affiliated with the school, we anticipate additional roles for faculty who have a home department in other schools across campus, but would like an affiliation with the Global School.
Departmental Staff: The faculty in the department are supported by three staff members: our administrative assistant who welcomes students to the Global Program and supports them and faculty in a variety of ways; our Director of Human Subjects Research and Academic Programs; and our Operations Manager for budget planning, oversight and expenses.

Resources Required
The Department of Integrative and Global Studies will require only modest net additional resources because almost all personnel and programming are in place already. The dean has already been budgeted and the search is ongoing. The associate dean position is also already in place.
Department Head: ***New*** Department Head to be hired following the procedures in the Faculty Handbook.
Faculty: There will be 26 full-time faculty in DIGS, one in year one of phased retirement. The administration demonstrated its support of this department by the addition of two tenure-track faculty and one tenured professor in July 2019. DIGS will be requesting tenure-track hires to

replace two TRT faculty who chose to retire this past summer. Additional faculty requests will be made through APBP as needed.
Office Space: While there is significant, ongoing inadequacy of departmental office space for faculty and staff (despite extensive sharing of offices term-by-term as temporary vacancies arise due to faculty travel), we have been assured that space will become available in the Project Center once the CDC moves into the new academic building.

Conclusion
The creation of a fully recognized department within the Global School will raise the stature of the faculty within the department. It will formally unify two groups of faculty with related interests that are grounded, place-based, and community-centered, with a practical, approach that is holistic and systems-oriented. Our shared activities will foster faculty development, as new research and academic programs emerge through a dedication to interdisciplinary research with real-world impacts. These programs will expand the reach of WPI and strengthen the opportunities for our students at all levels. The instantiation of a department will also simplify administrative operations. The cost is small; the payback large.

Appendix 1:
DIGS Faculty and Their Research Interests

Name	**Research Interests**
Bakermans, Marja	Wildlife, Ecology, Conservation Biology, Forest Management, Environmental Science, Ornithology
Balistrieri, Thomas	Male initiation practices, spirituality and psychology, Jungian archetypes depicted in modern culture (comic books and movies)
Belz, Melissa	Vernacular Architecture and Cultural Landscape Change, The Role of Traditions in Modernizing Societies, Food Systems and Sustainability, Smart Cities
Carrera, Fabio	Urban Information Systems, Urban Planning, Urban Studies, Emergent Systems, Complex Adaptive Systems
Chiarelli, James	Atlantic slave trade and the New World African diaspora, New World plantation and industrial archaeology, post-colonial socio-economic and environmental change, Caribbean and Latin America, historic preservation in the eastern U.S.
Davis, John-Michael	Political Ecology, International Development, Discard Studies, Community Engagement
Dehner, Corey	Public Drinking Water Policy, Differential exposures to environmental hazards, Community Engagement, Environmental Justice, Environmental Policy
Dodson, Leslie	Community Development, Climate Adaptation, Gender & Development, Water Resource Management, Social Entrepreneurship, Creative Scholarship, Experiential Learning
Doiron, Joe	Education innovation and entrepreneurship, leadership, PBL
Foo, Katherine	Urban Ecology, Environmental Governance, Landscape Design, Visualization, Environmental Justice
Golding, Dominic	Environmental Risk, Risk Communication, Vulnerability, Museum Studies
Hersh, Robert	Food systems, urban agriculture, brownfields revitalization, climate change adaptation, memory studies
Kurlanska, Courtney	Livelihood Studies, Sustainable Development, International Development, Microcredit and Microfinance, Social and Solidarity Economy

McCauley, Stephen	Climate Adaptation, Urban Planning, Energy Transition, Experiential Learning, Creative Scholarship
Pfeifer, Geoffrey	Phenomenology and Continental philosophy, Social and Political Philosophy, Social and Global Justice, Social and Political Theory
Rissmiller, Kent J	Energy Policy, Environmental Policy, Regulation and Regulatory Theory, Jurisprudence
Roberts, Laura	Nonprofit leadership & resource development, community engagement, global learning in a local context
Rosbach, Derren	Environmental Governance, Sustainability, Environmental Planning, Science and Technology Studies, Public Policy, Cross-Disciplinary Research
Shockey, Ingrid K	Environmental sociology, Interdisciplinary studies, Political ecology, Ethnography
Sphar, Jefferson A	International political economy, development, social and political theory, Latin American politics
Stanlick, Sarah	Civics & Global Citizenship, transformative learning, digital sociology, assessment, community-engaged learning and research, health & human rights, first generation & underrepresented students
Stoddard, Elisabeth	Critical Pedagogies, Social Justice and STEM, Human-Environment Geography, Environmental Justice and Policy, Climate Change and Hazard Vulnerability, Food Justice, Social Movements, Health Justice
Strauss, Sarah	Climate Change, Water, Energy Transitions; culture change and transnational processes; STS; narrative and environmental humanities; health, well-being, and the good life; embodied knowledge; intentional communities and community engagement; fieldwork in India, Europe, USA
Traver, Robert	Education/Science Education/Environmental Science
Tuler, Seth	Climate adaptation planning, Nuclear waste management, Long-term stewardship of contaminated sites, Public participation, Risk governance, urban planning, energy facility siting
Vaz, Richard	Project-based learning, Global learning, Curricular reform, Institutional change
Wobbe, Kristin	Project-based learning, First year programs, Curricular reform, Institutional change

Recent Publications:

Marja Bakermans

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2018. Pinpointing migratory and wintering locations to address full life-cycle conservation of Eastern Whip-poor-wills, Received 2018, William P. Wharton Trust, $4,990.

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Melissa Belz

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John-Michael Davis

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2017. Solutions for the Palestinian e-waste industry: Risk reduction and preparatory grant Swedish International Development Agency (Sida). (co-PI: **John-Michael Davis** and Yaakov Garb) $549,949 USD

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2018. Co-PI, Engineering Seed Grant, Net Zero Neighborhood: A Nexus of Food, Energy, and Water for Smart Cities. PI, Soroush Farzin-Moghadam; Co-PI, John Bergendahl. $5,000

2017. Co-PI, Davis Educational Foundation Grant, Supporting Worcester Polytechnic Institute in Effective and Equitable Teamwork (SWEET). PI, Emily Perlow. $240,000

2017. Project Scholar, Mass Humanities Grant, Arboretum Activation. PI, Sarah Connell, Intermediate School, Auburn. $7,500

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2017: Assessment of 17 VCAPS processes for climate change adaptation planning and hazard management for Carolinas Integrated Sciences and Assessments (CISA), University of South Carolina. $18,000

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2017. From Abbotsford to Aberdeen: Scotland's Energyscape in Transition. UW Center for Global Studies. With Carrick Eggleston. $6300

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Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Marsha Rolle, Chair)
Re: Motion to approve a new graduate degree program, the M.S. in Community Climate Adaptation (joint between the Department of Civil and Environmental Engineering in the School of Engineering and the Department of Integrative and Global Studies in the Global School).

Motion: The Committee on Graduate Studies and Research recommends, and I move, that a graduate program in Community Climate Adaptation (as described below) be established by the coordinated efforts of faculty from the above-mentioned departments and schools. This program will award an M.S. degree in Community Climate Adaptation.

The description of the M.S. and B.S./M.S. degree programs in Community Climate Adaptation to be included in the Graduate Catalog are provided below, followed by a rationale. This is a joint graduate program that will be administered by both DIGS and CEE.

Implementation Date for this action is Fall, 2021

Summary:

As the effects of global environmental change on local communities and surrounding regions become apparent, there is an urgent need to train professionals in the emergent field of climate adaptation (Moser, Coffee, and Selville 2017) in order to facilitate strategic action by local governments, businesses, and non-profits to achieve safe, thriving communities.

The professional Master's degree program in Community Climate Adaptation builds on WPI's distinctive interdisciplinary, project-based educational approach, making use of existing strengths, staff, and infrastructure to help expand student opportunities in the nascent, but rapidly growing, field of Climate Adaptation (in the previous paragraph, climate adaptation is not capitalized – but both sentences refer to the field of climate adaptation). This new graduate degree program brings together students from social science and technical backgrounds for sustained collaborative study, a radical departure from other offerings. CCA's innovative program structure supports our existing students for the BS/MS and MS options, while also inviting new kinds of graduate students to enroll.

Description of program for Graduate Catalog

The Community Climate Adaptation Master's program builds on WPI's distinctive interdisciplinary project-based approach, giving students training to support communities and organizations as they adapt to the impacts of a changing climate around the globe. Through this joint program between WPI's Department of Integrative and Global Studies and Department of Civil and Environmental Engineering, students can work with faculty across the university to gain collaborative and comparative perspectives on climate change adaptation strategies.

Program Rationale

In Massachusetts, the 2016 signing of Executive Order 569 by Governor Charlie Baker created an integrated climate change strategy for the Commonwealth, which has in turn invoked the development of a statewide hazard mitigation and climate adaptation plan. The same process has been underway around the country, as local and state governments recognize the need to take

action, and the severe weather, wildfires, and other climate-related problems of this summer have only underscored that need. Two thirds of American states, and communities from Miami to Houston, Anchorage to Kansas City, have all begun to plan how to protect their people and infrastructure from the impacts of climate change. Globally, locations as diverse as the Pacific Islands, mega-cities in Asia, and mountain communities in South America are confronting the critical need to adapt to our changing climate. This new Master's degree program can therefore help to satisfy a great and increasing need for expertise in community climate adaptation.

The program will implement the Graduate Global Projects Program (G^2P^2) framework (see Appendix A) for developing a professional project-based M.S. program that encourages the engagement of Global School faculty with faculty from other WPI departments and programs, exploring global "Grand Challenges" through study of a specific topical theme with global scope and local implications. This structure is ideal for collaborative, transdisciplinary, and joint programs with an anchor in both the Global School and another department or school, as the CCA program demonstrates. G^2P^2 is not a degree program itself, but an organizational structure that will help Global School/DIGS faculty train students to provide "Collaboration for a Better World," a theme that resonates throughout our program.

The framework builds on WPI's existing Global Projects Program infrastructure, which currently supports the undergraduate IQP and MQP experiences, to create high-impact Master's degree programs using existing sites and faculty to generate a graduate-level experience with breadth and depth across disciplines, sectors, and scales. Through substantive project-based learning experiences with diverse local partners in a 1.5 year master's degree program, our students will engage with a variety of themes that could range from climate action, global health, or energy systems, to international STS policy, environmental humanities, or collaborative management. By working in interdisciplinary teams across locations from Worcester to Wellington, Boston to Bangkok, WPI's Global School graduate students will develop comparative, collaborative, and holistic understandings of critical global problems, and they will be well-equipped to help solve them.

WPI's core interests, competencies, infrastructure, and reputation together infuse this new graduate degree program, offering a high reward, low risk strategy for Global School/DIGS success. Such a targeted interdisciplinary degree that includes both international and collaborative team-based training can position WPI well to seek funding, as well as creating specific giving opportunities for the WPI Capital Campaign. We expect that this focused degree program will provide great value for students though a unique participatory experience that is rarely found at the graduate level, as well as generating a strong foundation for faculty research and enhanced institutional impacts in the communities where we live and work.

WPI's Departments of Integrative & Global Studies (DIGS) and Civil & Environmental Engineering (CEE) together propose this initial offering, a collaborative M.S. degree (with a B.S./M.S. option) in Community Climate Adaptation that allows students to use their backgrounds in engineering, social sciences, and physical and biological sciences. The specific elements of this program are shown in Figure 1, below. The program uses a cohort-based structure that integrates students from technical and social science backgrounds into strong transdisciplinary teams working with an equally diverse group of faculty advisors to ensure effective engagement with real-world solutions. Upon beginning the program, students will be assigned to teams associated with one of WPI's more than fifty Project Centers; a local Massachusetts Project Center will always be included among the options. The specific site and process issues associated with their project will inform the entirety of their program, as well as

providing a comparative framework for the other teams. The team assignments will be based on a combination of factors related to their own skillset (foreign language, technical background, place-bound needs, etc.) and advisor/project center opportunities in a given year. In this way, we will capitalize on the synergistic strengths that individuals bring to the teams in technical and sociocultural arenas to create integrative project experiences that optimize use of the collective expertise of the team, rather than simply allowing team members to overlay basic content from their area of lesser expertise; the whole is indeed greater than the sum of the parts. The teams will learn that their capacity for problem-solving depends not on everyone bringing the "same" skillset to the table—however broad that might be—but rather on learning how to work together and with local communities to bring about positive impact.

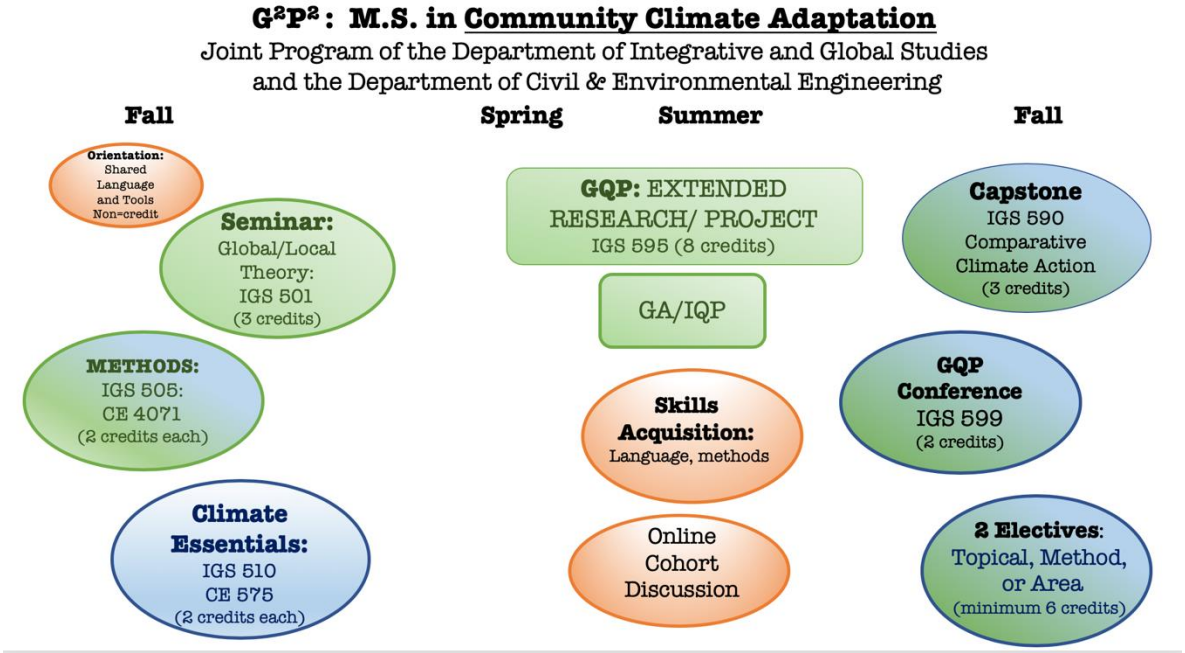


Figure 1: Proposed Master's Degree in Community Climate Adaptation

As depicted in Fig. 1, the program will include a non-credit orientation program during the first weeks of the initial semester of academic coursework. This integrative experience will help each new cohort develop a shared vocabulary and programmatic focus, as well as basic skills in teamwork and project management that they will be using throughout the program. Students will complete coursework in the three required areas of theory, method, and climate essentials in the first semester; if they complete courses in methods or climate essentials prior to admission to the CCA program, they may be able to instead choose an elective. There are 11 total credits in the first semester. The "Methods" required courses and the "Climate Essentials" courses are "split" courses that draw on expertise from both departments using the term structure to allow for two 2-credit courses to be paired for each of these requirements. This structure also allows more flexibility for the proposed B.S./M.S. program. The students will then spend four to six months at a Project Center, acquiring eight credits of project-based work. During that time, students will be in contact with their cohort and advisors (Online Cohort Discussions) to learn from one another, and will also develop skills appropriate to their research project (Skills Acquisition), such as learning additional research skills or studying foreign languages, which

may facilitate the completion of their site-based projects. Students will then return to campus for the final semester, when they will take a capstone seminar, two electives, and an additional team-based GQP conference (similar to "thesis credits" for the purpose of writing up the final project document), for a total of 11 credits. The total program is 30 credits. As part of the cohort seminars (Theory in the first semester and Capstone in the final semester), students will participate in the DIGS/Global School *Collaboration for a Better World* Seminar series, which will be open to the entire campus as well as the wider community.

Program Goals and Degree Objectives

The specific program emphasis on adaptation supports Master's graduates in acquiring theory and practice for climate adaptation jobs with NGOs, local/state governments, and other institutions or businesses. Today's communities must respond to actual and projected problems of infrastructure inadequacy; potential loss of land and economic assets; water resource and water quality impacts; differential health and social impacts; extreme weather events; coordination with multiple agencies; and compliance with local/state/federal policy decisions, as they navigate the environmental, policy, and built-environment constraints imposed by the reality of climate change. Addressing such problems will require innovative thinking about the both technical and social-economic-cultural dimensions of both problems and solutions. The degree objectives (provided below) can be fully achieved through participation in teams that include different kinds of expertise. Depending on a students' undergraduate background, graduates of the program could be on a path towards more technical careers, addressing climate adaptation through engineering solutions, or find employment as analysts, advocates, program managers, and community organizers. Broad goals for content and skill development are outlined below in three domains (see Fig. 2, below).

Understanding climate change impacts

- Characterize the ways that climate change and associated uncertainties impact food, energy, water, and social-ecological systems in specific localities
- Analyze the local challenges of adapting to climate change, including the ways that transition to a low-carbon economy influences global and regional development

Forging pathways to adaptation

- Demonstrate an ability to develop, implement, and monitor alternative solutions to climate adaptation that incorporate sociocultural, technical, economic, and ethical dimensions, as well as an appreciation for public-private collaboration and a multilevel governance approach.
- Promote an approach to transformative change that employs a community-based relational perspective as well as an understanding of technical feasibility to identify shared visions, values, ideas, and actions around adaptation and resilience

Partnering for and enacting community change

- Plan, design, and evaluate sustainable, low carbon, adaptive, resilient community-based solutions to problems associated with climate impacts and the built environment.
- Lead diverse groups of people in defining a shared adaptation action agenda, including agreed measures of progress and success, while building collaborative

adaptation and resilience policy and practice solutions that address social justice concerns.

Figure 2: Degree Objectives

Outcomes/Opportunities

Students completing this Master's program will develop approaches to solving problems, and address critical technical, cultural, socioeconomic, and policy issues related to climate change adaptation in unique communities. Our goal is to develop a range of opportunities for both students and faculty in ways that might leverage local sponsorship or grant-funded projects. The program is ideal for individuals with both technical and non-technical backgrounds who are looking to increase their skills and knowledge in relation to the multitude of interdisciplinary problems related to climate adaptation and mitigation such as water management, green energy transitions, community action plans for storm preparedness, and green building/retrofits for climate adaptation. In fact, the program is designed to integrate opportunities for learning and expanding knowledge of both technical and non-technical backgrounds, and we encourage students with a wide range of academic and practical experience to apply.

As we see more and more of these climate change impacts now and into the future, an increased demand for people with the kinds of skills and knowledge of the environmental and social issues that this program delivers will follow. Our distinctive project-based approach will help students gain hands-on experience and prepare them to work in the public, private, and non-profit sectors as experts in climate adaptation in ways that will compliment and extend their existing backgrounds and help them develop innovative approaches to solving critical climate related environmental and social problems. Job opportunities for our graduates include local and state governments, NGOs, and businesses preparing for a climate-impacted future, as well as local or regional branches of federal agencies such as USGS or USFS and state/national parks and historic monuments (Moser, Coffee, and Selville 2017).

Student Outcomes and Deliverables

In order to assess student growth and success in the program, we must design with the intention of what we see to be a "successful" graduate of the program. There are many ways to define success that are traditionally measured – metrics about job placement, passing a comprehensive exam, creation of a cumultative thesis paper – and we want to be sure the values and intentions of the program are being met by those criteria. Such assessment needs to take into account the unique and defining characteristics of WPI's education in project-based global learning, as well as the program's intent to nurture capable and informed citizen-leaders.

As stated above, the large-scale objectives for the program include partnering for and enacting community change, forging pathways to adaptation, and understanding climate change. If we design assessment with those in mind, the need for attitude/behavioral metrics, content mastery, and individual civic empowerment become key indicators of a program successfully completed. Metrics for those pieces would then include measurements/opportunities to test: content mastery (getting the information), critical reflection (making connections across knowledge, skills, attitudes, and one's identity as a climate change scholar), and knowledge curation (understanding the research process and developing skills to create and communicate knowledge).

To design for these many domains, we advocate for a developmental portfolio that will be created throughout the student's time pursuing the Master's. A digital portfolio manager –

which can be as basic as an multi-layered Wordpress website with articulated attributes, milestones or a dedicated ePortfolio system – can be used to track important milestones over time. Elements of this portfolio may include:

- Satisfaction of class assignments and passing grades in each course
- Individual depth competency papers/projects from the first and third semester cohort seminars
- A year-one team-based critical reflection designed to connect knowledge gained in the courses and GQP experiences
- Community evaluation and feedback related to project process and outcomes
- Participation in the GRIE Poster Competition at WPI or poster presentation off-campus
- Satisfactory completion of the GQP, team defense, and report
- A final summative critical reflection paper or presentation that articulates evidence of learning goals attained by the student teams (some of these will come from the program, some will be created by the students for their specific team GQP)

Comparison with Existing Programs and Market Analysis

This program is unique in its combination of interdisciplinary training with comparative and experiential learning at WPI sites around the globe. Per the market analysis, most graduate programs in climate change focus on policy and/or management, despite the great and growing need for climate adaptation. Increasingly, both communities and corporations are pledging carbon-neutrality and other forms of climate action, but there are few trained specialists to help them achieve these goals. We requested a analysis from WPI's market research team in Academic Affairs, and what follows here is a summary of that report, authored by Kyle McAlice.

There are three main areas that support the creation of a Master's program in Community Climate Action. First there is a growing job market for people with Master's in climate change and other related careers; second, the majority of Master's programs out there do not focus on the technical aspect of the degree, but instead center on policy and social considerations; and third, there is a history of funding for these kinds of programs.

Job Market

According to the Kaiser Family Foundation and the Washington Post (2018) there is a strong market for education relating to climate adaptation, and there is a projected growth of 11% (faster than average) in employment for 2016-2026 for Environmental Science and Specialties (BLS). One particular specialty experiencing major growth is that of a Climate Change Analyst, which has a projected growth of 12% (faster than average). A Master's degree is required in the Climate Change Analyst profession.

Degree Programs

There are currently 110 universities offering a graduate degree in Atmospheric Sciences, Meteorology, Climate Change, and Energy Policy in the United States; the majority of these, however, focus on the physical sciences. The report reviewed 25 that had a particular relevance to climate change. While all of them did require a capstone, internship, or time in the field, it is important to note that only two were engineering-degree based, and the majority of the niche climate change programs were focused on policy or management.

Funding

The report highlights that the National Science Foundation has a history of funding programs on climate change. It also notes that this might be an appropriate program for the Innovations in Graduate Education Grant (also from the NSF), which WPI has been awarded on two previous occasions. The NSF NRT grant would also match well with this program.

McAlice writes that "Industry expansion has shifted towards the catalysts of change from technical and interdisciplinary standpoints. That can be loosely defined as the scientific experts like climatologists, technical experts like engineers, and interdisciplinary change agents like climate change analysts, environmental scientists, and sustainability experts" (2020:7). Our interdisciplinary approach between the Global School and CEE seems well suited to meet this challenge.

The report suggests that Climate Change Adaptation could be offered as a concentration within existing or new degree programs. However, the report also notes an opportunity in the Climate Change education arena. Compared to other recent research efforts, there are far fewer degree opportunities related to the proposed program in Community Climate Adaptation. This provides an opportunity to enter a new market in a field that is widely known to be rapidly expanding. WPI has an opportunity to leverage vast experience with project work, and STEM expertise, in a field that is otherwise dominated by physical science and policy. Therefore, we believe that the time is right for a bold and innovative program focused on the integration of technological and social skills to support communities in addressing climate change impacts around the globe—with a name that clearly states the outcomes we aim to deliver.

Comparison to Existing Programs at WPI

WPI currently has no other graduate program that specifically focuses on climate change adaptation. The CCA program has been developed to complement rather than overlap the emerging Global School Master's programs, and to provide an opportunity for the Global School to work closely with the School of Engineering on a focused interdisciplinary degree.

Impact on Existing Programs at WPI

There has been considerable student interest in climate change coursework, as noted by the directors of the ENVS program, who conducted focus groups on campus to see if a climate track for the ENVS undergraduate program would be viable; they learned that students sought a BS/MS option as well as graduate training in this area (Stoddard and Elgert, personal communication).

Admissions Requirements for M.S. Degree (See Appendix B for full Graduate Catalog copy)

BA or BS degree in social science, environmental science/studies, physical sciences, biological sciences, engineering or other relevant field, with minimum 3.25 GPA

- A completed Application for Admission to Graduate Study.
- A non-refundable $70 application fee (waived for WPI alumni and matriculating WPI students).
- College transcripts in English and the original language from all accredited degree-granting institutions attended. Admitted students must provide official transcripts with an indication that the bachelor's degree has been awarded before they matriculate.

- Three letters of recommendation from individuals who can comment on the applicant's qualifications for pursuing graduate study in the chosen field. Applicants are required to invite their recommenders to submit letters through the online application only.
- Statement of purpose. This is a brief essay discussing background, interests, academic intent, and the reasons the applicant feels s/he would benefit from the program. The statement of purpose must be submitted electronically with the online application.

Anticipated 6-12 students in first two cohorts, increasing to 16-20 in subsequent years, with possibility of expanding to have both Fall and Spring semester cohort admissions as well as online opportunities for completion of stackable modules. These possible variations, however, are not addressed in this proposal.

Degree Requirements

The Community Climate Adaptation program requires three semesters plus summers to complete. Students will take a minimum of 30 credit hours, of which 10 credit hours will be the GQP. We expect to draw candidates with diverse academic backgrounds.

Once admitted, the students will participate in an online community-building program combined with an onsite orientation program in August, in order to facilitate a shared vocabulary and understanding and support a rapid start once the cohort begins their first semester.

To note: All of the proposed GS graduate programs will need to address the question of dual-listing of undergraduate/graduate courses, especially electives, to maximize the opportunities for dual degree programs.

Basic Academic Program:

Orientation: non-credit preparatory activities during first semester: shared language and basic skills
Semester 1: 11 credits in 3 Core Areas: Theory, Methods, and Climate Essentials
Semester 2 (plus optional summer/break): 8 credits of GQP
Semester 3: 11 credits:3 credits of Core Area (Comparative Climate Action Capstone), 2 credits of GQP, and minimum 6 credits of elective
TOTAL: 30 credits

Core Courses (11 credits in 1st semester; 3 credits in 3rd semester)

IGS 501	*Seminar: Theorizing Place, Community, and Global Environmental Change* - first semester (3 credits, new course, team taught by K. Foo or other core CCA-DIGS Faculty)
IGS 505	*Qualitative Methods for Community-Engaged Research* – A term (2 credits, new course, taught by core CCA- DIGS faculty)
CEE 4071	*Land Use, Development, and Controls* – B term (2 credits, existing course)
CEE 575	*Climate and the Earth System* – A term (2 credits, new course, taught by C. Eggleston); course supports possible Climate track in ENVS
IGS 510	*Human Dimensions of Global Environmental Change* – B term (2 credits, new course, taught by S. Strauss); course supports possible Climate track in ENVS degree program.
IGS 590	*Capstone Seminar: Comparative Climate Action* – final semester (3 credits, new course, team taught by core DIGS/CEE Faculty)

Collaboration for a Better World: Global School/DIGS Speaker Series— (non-credit but required)

GQP Credits

Total of 10 credits: IGS 595, 8 credits in 2nd semester of field placement at project center, with possible extension into summer. IGS 599, 2 credits of project work/writing in 3rd semester.

Elective Courses (minimum 6 credits: two courses each in 3rd semester, or in 1st if other requirements already met—see Appendix B).
Proposed elective: IGS 545 *Climate Change: Vulnerability and Mitigation* (Cat. II) 3 credits, Spring

In the future, more elective courses may be added from existing ENVS and other undergraduate classes; if that becomes possible, we will create dual-listed graduate sections and commensurate course requirements for these classes, including an additional hour of discussion each week, as well as different/additional readings and assignments. This strategy allows us to conserve teaching staff while adding depth to existing curricular options. The expectation is that the graduate degree program requires enrollment in 5XX level classes, but that this can be achieved without the obligation of creating entirely new courses or assigning new faculty. This challenge is shared by most of the proposed Global School graduate degree programs. We have, as noted, created one additional IGS elective for the program, which may also be of interest to students in the IDEaS program or other existing graduate programs. At this time, students interested in a graduate level independent study in environmental studies or environmental policy may request permission for participating in such opportunities.

GQP (second semester)

During the second semester, each GQP team (3-5 teams expected for a given cohort) will travel with an IQP group in first term and stay for a subsequent term into summer or winter break. Traveling with an IQP group addresses potential risk management issues with off-campus travel, and provides an opportunity for the graduate students and the IQP teams to interact, exchange ideas, and learn from one another. The graduate students will receive 8 credit hours for the entire period. Each graduate student will receive airfare and lodging to cover the cost of their travel. These funds are similar to the Global Scholarships provided to undergraduate students for IQPs, and supports the GQP as a programmatic guarantee for all students in the CCA program.

The graduate student teams will travel with an IQP group to a project center in Massachusetts or on other continents, and begin their own projects addressing a climate change-related action, while also helping undergraduates and advisors with their projects. Working in the field will provide critical challenges to the GQP team members' global competency. As a result, their understanding and knowledge of the relationship between climate change and implications for the local culture will be deeper and more nuanced than it would be were they not in the field. Building on the foundations of the online community established in the initial summer preparation/orientation, student/advisor discussion will continue, comparing the issues they are exploring in their local communities. In addition, students will have opportunities to deepen their knowledge of local language, history, water management or building practices, or other desired focus.

Participating Project Centers will vary depending on topic and advising assignments, but there will always be a local option for one team to be based in Massachusetts. The decision matrix for determining best available Project Center locations for graduate groups is attached (Appendix C). The intention behind this activity was to start a discussion around how to launch and scale the global project centers that support the proposed graduate student projects in climate change adaptation. We created a process to help us understand the best places to launch an initial cohort—and then identified the additional places to begin to scale these specific global projects. The criteria that were developed are "draft criteria." They were our best guesses at what would be important in making a decision on where to start and eventually where to expand, and will likely change.

Preliminary assessment suggests that Cuenca, Ecuador; Melbourne, Australia; possibly Mandi, India (requires D/E instead of C/D); Campinas, Brazil; and multiple Massachusetts locations would be good options for the initial cohort in this program. Possible additions for later cohorts include Venice, Italy; Cape Town, South Africa; and Sharjah, UAE.

Affiliated Departments

Department of Integrative and Global Studies (DIGS)
Department of Civil and Environmental Engineering (CEE)

Faculty Contacts/Program Management

Sarah Strauss (Co-Director, DIGS Academic Programs Committee)
Jeanine Dudle (Co-Director, CEE Curriculum Committee)

Faculty (Instructors/Center Directors/Advisors)

DIGS: Strauss, Shockey, McCauley, Stanlick, Tuler, Pfeifer, Stoddard, Kurlanska, Rosbach, Doiron, Foo, Belz, Dodson, Davis
CEE: Bergendahl, Eggleston, Dudle, Mathisen, Abu-Lail, Walker, LePage
Other affiliated GS faculty according to interest (e.g., Elgert, San Martin, Hansen, Kreuger)

Resources Required

The program requires (a) 13 credit hours of new courses, (b) existing courses as electives, and (c) 3-5 additional advisors per cohort. We request one FTE faculty member to support the program, across DIGS/CEE, with the possibility of adding another in Year 5 if the numbers warrant. Some of the DIGS faculty have already been teaching many of the listed electives, so teaching loads in the new department might shift somewhat to include these content courses on load in DIGS, thereby serving multiple programs). Staffing for the program is estimated at 1.0 FTE for new TT faculty, adjunct faculty to teach 3-4 courses to allow existing faculty to teach content courses on load, and 0.25 FTE administrative assistance, with this coming in the person of the anticipated administrative hire to support the new Dean (1 FTE= 0.5 Dean Admin; 0.25 Global Lab; 0.25 Grad Programs). Assuming a minimal start of 8 graduate students in the first year, ramping up by 1 team/year, the program is self-sustaining, with possible net positive income of $112,000 to $573,000 annually over the five year period. See Appendix D for more detailed funding model.

Funding, Research, and Development Opportunities

Faculty across the university with an existing interest in climate change research can become involved in supporting student projects around the world and at home, collecting pilot data for grant proposals as well as developing interdisciplinary research collaborations with our global partners. As climate adaptation often involves aspects of the built environment as well as environmental stewardship and remediation, there is great potential for synergy between this joint graduate program and the proposed CEE Center for the Built Environment. We anticipate opportunities to develop expertise for new research and educational opportunities in architectural engineering, for example, both through existing faculty and with possible future hires. We also expect that this program will generate and support new faculty and student research related to community climate adaptation that intersects well with a variety of other initiatives under exploration at WPI, ranging from global health to the material, management, and policy shifts critical for transitioning to a circular economy.

The DIGS Academic Programs Committee will seek outside support through the NSF NRT program (deadline Winter 2021) and other funding agencies, which would help enormously with both recruiting for and sustaining a new graduate program. Other grant opportunities may include the new Bezos Earth Fund, the NSF IRES (International Research Experience for Students), and more that are as yet unidentified. New kinds of Global School faculty fellowships might support advisors to go to particular centers and develop pilot research projects with students, to obtain sufficient data for writing a larger NSF or other grant proposal.

The G^2P^2 approach lends itself well to development opportunities in the WPI capital campaign. Alumni and other donors with specific interdisciplinary topical interests might choose to support graduate teams for climate adaptation in different locations, or to support a specific project center to increase capacity to add graduate student teams.

Program Assessment

This program makes use of existing faculty and infrastructure, as well as offering new opportunities for existing faculty, as well as new hires, to teach and research in new arenas. We will develop a process to monitor student and faculty outcomes and ensure sustainable growth of the program in the coming years. As the program is established, program outcomes will be articulated and a system will be established to evaluate the program relative to them. In addition, the evaluation system will include measures of the following: student satisfaction, post-graduation activities, student perceptions of quality of their experience, and faculty perceptions of program quality and opportunities to improve program quality and sustainability.

Implementation Date/Timeline

The proposed Community Climate Adaptation Program will advertise for admissions in 2020-21, and bring the first student cohort to campus in August of 2021.

AY 19-20	Program development
Summer 20/AY 20-21	Program Approval; Design and develop set of new core courses
AY 20-21	Develop web presence and marketing materials
AY 20-21	Recruit applicants and Admit new students
AY 21-22	First cohort arrives on campus, completes first year of program
AY 22-23	First cohort completes master's degree program (Fall 22)
AY 22-23	Evaluate Program, enhance /modify as appropriate

References

2017 Moser, Susanne, Joyce Coffee and Aleka Seville (2017) Rising to the Challenge, Together: A Review and Critical Assessment of the State of the US Climate Adaptation Field. A Report Prepared for the Kresge Foundation. https://kresge.org/content/rising-challenge-together

Resources for funding climate action GQPs:

Worcester: https://kresge.org/content/climate-resilience-and-urban-opportunity-0 and https://kresge.org/CCHE

Nantucket/Boston: https://www.mass.gov/service-details/coastal-resilience-grant-program

APPENDIX A: G^2P^2 Framework

Collaboration for a Better World: WPI's Graduate Global Projects Program (G^2P^2)

What

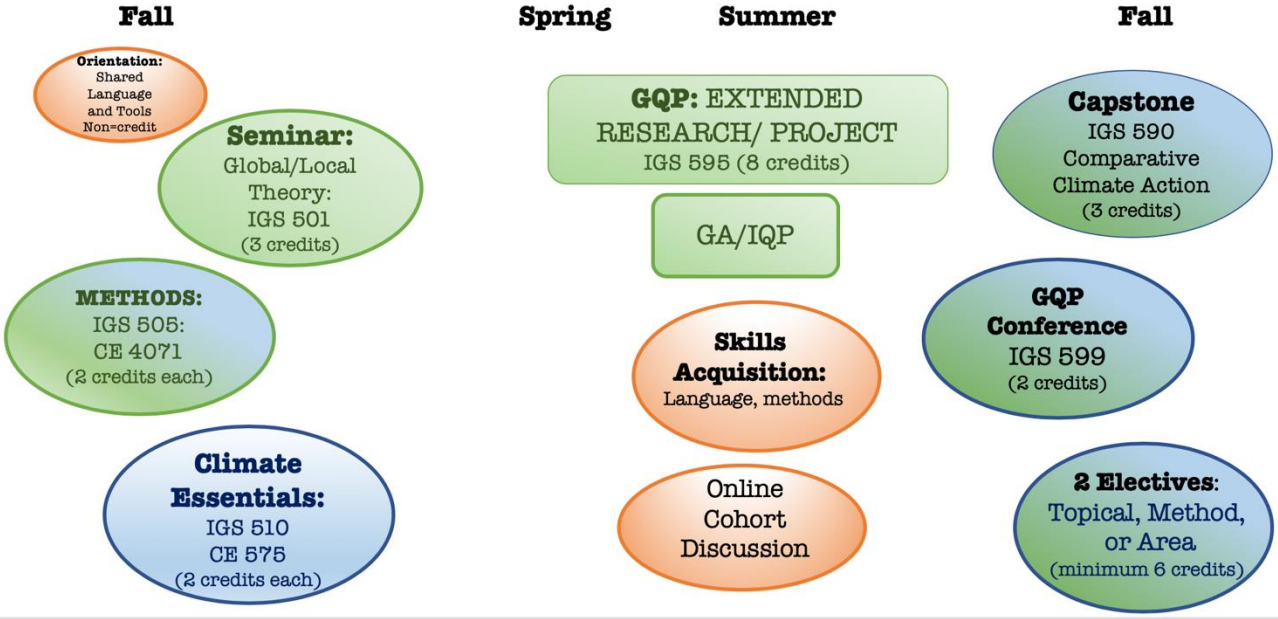
- Holistic project-based Master's program framework (option for WPI student 3.5 +1.5 BS/MS)
- Collaboration of GS and other departments/programs, depending on topical theme
- Modeled on Global Projects Program IQP infrastructure and philosophy, using existing sites and faculty to develop more intense graduate level experience across disciplines, sectors, and scales
- Extends PBL with diverse local partners, but engages deeply on one theme in critical areas: Collaboration, prep, time on project, cultural knowledge, breadth and depth, reflection = **"Impact"**

Why

- A great experience for students and strong foundation for faculty research and enhanced impacts.
- Flexible and scalable to diverse themes (GS Clusters, Grand Challenges, development, public health, STEM education, urban/rural planning, etc.) and partners (at WPI and elsewhere.)
- High reward, lower risk strategy for Global School success:
  - Builds on core WPI/GS interests, competencies, infrastructure, reputation
  - Resource efficient and highly marketable
  - Eligible for NSF funding, which would increase viability and visibility
  - Good target for Capital Campaign giving, for support of student projects and faculty research

G^2P^2 : M.S. in Community Climate Adaptation

Joint Program of the Department of Integrative and Global Studies
and the Department of Civil & Environmental Engineering



Fundamentals of the MS degree program in Community Climate Adaptation

- 3 Semesters plus summers to completion: 30 course credits to degree, 10 of which are project-based. Cohorts could eventually start in August or January.
- MS track as well as 3.5 plus 1.5 B.S./M.S. for existing WPI students (can also dovetail with potential undergrad ENVS Climate track)
- First Semester: Students assigned to interdisciplinary teams of 4, and take courses in three required areas—Theory, Method, and Climate Change—for total of 11 credits. Non-Credit Orientation also required for "shared language" cohort-building activities, which includes skill building in teamwork and project management.
- Second Semester: Travel with an IQP group in first term, and stay in that location for subsequent term into summer or winter break. GA responsibilities for first term; 8 credits for entire period.
- Third Semester/final summer: Capstone seminar; 2 Electives; project conference credit: Total 11 credits.
- Degree based on both final team project and individual competency, with Group Project Defense and individual depth/competency papers or projects in Global/Local Theory and Capstone Seminars.
- Potential for eventual collaboration on various interdisciplinary topics: Climate, Social Justice, Health, Global Studies

APPENDIX B:
GRADUATE CATALOG COPY, COURSE PROPOSALS, AND POSSIBLE ELECTIVES

Graduate Catalog Copy:
Community Climate Adaptation

Faculty
S. Strauss, Director and Professor; Ph.D., University of Pennsylvania; energy, global environmental change, water and weather: risks, perceptions, and societal impacts, cultural conceptions of health and illness, transnational cultural processes and practices, mountain regions (Alps/Himalaya/Rockies), India, Switzerland, Scotland.

J. D. Dudle, Co-Director and Associate Professor; Ph.D., University of Massachusetts Amherst; surface water quality, drinking water treatment, public health.

L. Abu-Lail, Assistant Teaching Professor; Ph.D., Worcester Polytechnic Institute; unit operations of chemical engineering, water treatment, hydraulics, environmental organic chemistry.

M. Belz, Associate Teaching Professor, Ph.D. Kansas State University; cultural geography, architecture and development.

J. Bergendahl, Associate Professor; Ph.D., University of Connecticut; industrial and domestic wastewater treatment, particulate processes in the environment, chemical oxidation of contaminants.

J-M Davis, Assistant Teaching Professor; Ph.D., Memorial University of Newfoundland; geography.

J. Doiron, Assistant Teaching Professor; Ph.D., Boston University; higher education, leadership, innovation.

C. Eggleston, Professor & Department Head of Civil and Environmental Engineering; Ph.D., Stanford University; natural materials and how they interact with the environment in which we live, focusing on the fundamental processes of adsorption, dissolution/growth, electron transfer, and catalysis.

K. Foo, Assistant Teaching Professor; Ph.D., Clark University; urban geography, human-environment geography, landscape architecture.

C. B. Kurlanska, Assistant Teaching Professor, Ph.D., State University of New York at Albany; livelihood studies, community economy, social and solidarity economy, community development.

S. LePage, Instructor; M.S., Worcester Polytechnic Institute; urban and environmental planning, stormwater management, sustainable solutions to food, water and energy management.

P. P. Mathisen, Associate Professor; Ph.D., Massachusetts Institute of Technology; water resources and environmental fluid dynamics, contaminant fate and transport in groundwater and surface water, exchanges across the sediment-water interface.
S. McCauley, Associate Teaching Professor; Ph.D., Clark University; human-environment geography, urban geography, GIS.

G. Pfeifer, Associate Teaching Professor; Ph.D., University of South Florida; philosophy, social and political philosophy, global justice, and globalization.

D. Rosbach, Associate Teaching Professor; Ph.D., Virginia Tech; planning, governance and globalization.

I. Shockey, Associate Teaching Professor; Ph.D., Brandeis University; environmental sociology, climate change, ethnography

S. Stanlick, Assistant Professor; Ph.D., Lehigh University; learning sciences and technology, global citizenship

L. Stoddard, Associate Teaching Professor; Ph.D., Clark University; human-environment geography

S. Tuler, Associate Professor, Ph.D., Clark University; environmental science and policy, climate change

H. Walker, Schwaber Professor of Environmental Engineering, Ph.D., University of California, Irvine; water quality, emerging contaminants, water and wastewater treatment, environmental nanotechnology, membrane processes.

Program of Study
The Climate Change Adaptation (CCA) program offers graduate studies toward an M.S. degree, with the option for participating in the B.S./M.S. program. The CCA program builds on WPI's distinctive interdisciplinary project-based approach, giving students training to support communities and organizations as they adapt to the impacts of a changing climate around the globe. The program uses a cohort-based structure to integrate students from technical and social science background into transdisciplinary teams to gain collaborative and comparative perspectives on adaptation strategies. The program is designed to follow a full-time, cohort-based model, but limited flexibility exists to cover the coursework over a period of time longer than the prescribed 18 month model.

Admissions Requirements
Candidates for admission to the M.S. program must meet WPI's requirements, and are expected to have a bachelor's degree in social science, environmental studies/science, physical sciences, biological sciences, engineering, or other relevant field, with a minimum 3.25 GPA.

Degree Requirements

For the M.S. Community Climate Change Adaptation, the student is required to complete a minimum of 30 graduate credit hours. This includes a required non-credit orientation during the first semester. The Graduate Qualifying Project (GQP) provides a field-based experience to understand climate change impacts; forge pathways to adaptation; and enact community change. GQP's are carried out in cooperation with local partners and with the approval and oversight of faculty advisors. The program requirements are presented below.

Master of Science
Students pursuing an M.S. degree must complete a minimum of 30 graduate credit hours of work: 14 graduate credits of Core courses; 10 graduate credits hours of GQP; and 6 graduate credit hours of electives. Course and project requirements are detailed below.

1. Core Courses (14 graduate credits)
   IGS 501 Theorizing Place, Community, and Global Environmental Change (3 credits)
   IGS 505 Qualitative Methods for Community-Engaged Research (2 credits)
   CE 4071 Land Use, Development, and Controls (2 credits)
   CE 575 Climate and the Earth System (2 credits)
   IGS 510 Human Dimensions of Global Environmental Change (2 credits)
   IGS 590 Capstone Seminar: Comparative Climate Action (3 credits)

2. Graduate Qualifying Project (10 graduate credits)
   IGS 595 Graduate Qualifying Project Research (8 credits)
   IGS 599 Graduate Qualifying Project Conference (2 credits)

3. Elective Courses (minimum of 6 graduate credits)
   Elective courses may be chosen from the list of courses provided in the program handbook. Courses are selected based on personal interest and experience. Elective courses must be approved by the program committee prior to completion.

Combined Bachelor's/Master's Program
Students enrolled in the Bachelor's/Master's program must satisfy all the program requirements of their respective Bachelor's degree and all of the program requirements of the Master's degree in Climate Change Adaptation. A maximum of four courses may be counted toward both the undergraduate and graduate degrees. Double-counted graduate credits must be in courses, and cannot be in qualifying project work. A maximum of six graduate credits may be double-counted in Elective Courses and a maximum of six graduate credits may be double counted in Core courses. Elective courses must be at the 4000-level or above. Completion of Core courses must be pre-approved by the program because of the cohort nature of the graduate degree. A grade of B or better is required for any course to be counted toward both degrees. Acceptance into the Bachelor's/Master's program means that the candidate is qualified for graduate school, and signifies approval of the graduate credits listed for credit toward both the undergraduate and graduate degrees.

Global Project Centers

The WPI Global Projects Program allows WPI students to immerse themselves in new cultures and tackle unstructured problems in ways that are meaningful to local communities. The WPI Global Projects Program includes a diverse array of project locations in over 31 countries throughout the world. The project locations range from large international cities to small mountainside villages, and these sites serve as host locations for the GQP in the CCA program.

Course Descriptions for Core Classes (Proposed New)

IGS 501 *Theorizing Place, Community, and Global Environmental Change* (Cat. I) 3 credits, Fall term.
This proseminar explores the relationship between global and local contexts at different scales, with a focus on how communities can change and thrive under conditions of global environmental change. We explore the theoretical and practical understandings of, and strategies for, cultural and technological change as enacted in specific places by people whose identities, practices, and values vary widely, and who are impacted differentially by the historical, structural, and environmental conditions that they both create and encounter. Students will complete an individual depth assignment that could be a substantive research paper, project proposal, or community service activity for the degree portfolio. They will also participate in the DIGS/Global School Speaker Series, and will use that content to engage with course readings as well as their own projects.

IGS 505 *Qualitative Methods for Community-Engaged Research* (Cat. I) A, 2 credits
This course advances student knowledge of research design and methods, emphasizing frameworks, strategies, and qualitative methods for community-engaged studies. In this course, students engage with alternative frameworks, including community based (participatory) research and citizen science, to build understandings about the continuum of the research process. Process elements include planning and design, implementation, evaluation, dissemination, and assessing policy implications, as they are applied in deeply collaborative action research settings. This course explores strengths, weaknesses, and challenges of different data gathering and analytic methods through exploration of prior studies, and considers how these research approaches intersect with social, cultural, and institutional practices and ethical standards. Students work in teams to develop proposals for a Graduate Qualifying Project that addresses the needs of an outside project partner.

IGS 510 *Human Dimensions of Global Environmental Change.* (Cat. I). 2 credits, B term
This course provides the groundwork for understanding the historical, sociocultural, and political-economic impacts of climate change in the Anthropocene. Building upon a basic understanding of climate science, this course addresses how global environmental change is mediated by social, political, economic and cultural systems. Case studies are used to scrutinize how efforts to mitigate and adapt to impacts can overcome or exacerbate existing inequities. Through a focus on how responses emerge in specific places and times, students explore how they can play a role in efforts by communities around the world as these communities adapt to existing and developing environmental changes, face decisions about retreat, and plan for the future.

IGS 545 *Climate Change: Vulnerability and Mitigation* (Cat. II) 3 credits, Spring

Taking climate change as a starting point, this course introduces students to a wide range of climate change conditions, human responses to those conditions, and points toward the need for deeper understanding of human-environment relationships. The course will draw from Geography, Economics, Global Environmental Change, and other cross cutting disciplines for theory and case studies. Examples of climate change risks and mitigation efforts will come from the developed and developing world and will include both urban and rural examples. Assessment techniques include small group projects, case-based testing, and in class and online discussions.

IGS 590 *Capstone Seminar: Comparative Climate Action*. (Cat. I). 3 credits, Fall
This seminar analyzes core themes of the Community Climate Adaptation Program during the students' third and final semester. Bridging the disciplines of geography, anthropology, and civil & environmental engineering, we draw together the insights and experiences learned by technical and social science students during the first two semesters of the program. Through a combination of readings, case studies, and an individual depth project, the course provides an opportunity for students to revisit theoretical frameworks for climate adaptation strategies in a way that is informed by their place-based applied research in diverse places internationally. We explore similarities and differences observed in different localities across scales in order to strengthen an empirically-grounded, comparative, and holistic analysis of community climate adaptation. In doing so, we investigate both positive resonances between theoretical frameworks and demonstrated outcomes in discrete places, while we also critically probe any gaps, tensions, and surprises that may emerge from the GQP fieldwork. Participation in the DIGS/GS speaker series is required for this course, as the topics and guests will provide additional content for consideration.

IGS 595 *Graduate Qualifying Project Research* (Cat I) Spring, 3-8 credits
The eight-credit graduate qualifying project (GQP), typically done in in teams, is to be carried out in cooperation with an external partner, and it is overseen by two faculty members representing both the Department of Integrated and Global Studies and Civil & Environmental Engineering. Student teams seek to answer a climate adaptation question identified and explained by the external partner. The student teams conduct applied research using goals, objectives, and methods developed in the core Methods courses for the CCA program, based on this driving question and under the joint guidance of two WPI faculty advisors and the external partner. The course is full-time and structured by two weekly meetings with the faculty advisors and external partner. Professional development skills, such as oral and written communication, teamwork, leadership, and collaborative problem-solving will be practiced as the research is completed across a full semester.

IGS 599 *Graduate Qualifying Project Conference* (Cat I) Fall, 1-3 credits
The graduate qualifying project (GQP), typically done in in teams, is to be carried out in cooperation with a sponsor or external partner, and it is overseen by two faculty members representing both the Department of Integrated and Global Studies and Civil & Environmental Engineering. This three-credit Conference course integrates theory and practice of community climate adaptation strategies, and it should address and build upon the frameworks and tools acquired in the research phase of the program. Deliverables for this course consist of a written report and public presentation to the WPI community and external partner.
CE 575 *Climate and the Earth System* (Cat. I.) 2 credits, A term

This course deals with the Earth's operation as a system, covering its energy budget along with its interacting atmosphere, ocean, biosphere and geologic systems. By showing how all systems work together to form feedback loops that can amplify or counteract input perturbations and forcings of the overall system, the course illustrates how these systems modulate and control our planet's climate system. Throughout, an Anthropocene point of view is taken to study not only "natural" systems but also the ways in which human societies interact with and are an integral part of the Earth system. The course integrates physical, chemical, and biological basics to arrive at an understanding of complex natural and human systems.

CEE ELECTIVES

CE 4061. Hydrology (**Mathisen**)
CE 402X Resilient Infrastructure for a Changing Climate (**Mallick**)
CE/CHE 4063. Transport & Transformations in the Environment **(Kmiotek, CHE)**
CE 542. Geohydrology. **(Mathisen)**
CE 560. Advanced Principles of Water Treatment. **(Dudle)**
CE 561. Advanced Principles of Wastewater Treatment. **(Walker)**
CE 562. Biosystems in Environmental Engineering. **(Abu-Lail)**
CE 563. Industrial Waste Treatment (**Bergendahl**)
CE 565. Surface Water Quality Modeling. **(Dudle)**
CE 566. Groundwater Flow and Pollution (**Mathisen**)
CE 567. Hazardous Waste: Containment, Treatment and Prevention (**Bergendahl**)
CE 570. Contaminant Fate and Transport (**Mathisen**)
CE 571 Water Chemistry **(Dudle)**
CE 572. Physical and Chemical Treatment (**Bergendahl**)
CE 573. Treatment System Hydraulics (**Bergendahl**)
CE 574. Water Resources Management **(Mathisen)**

GLOBAL STUDIES, SOCIAL SCIENCE, BUSINESS, AND OTHER ELECTIVES
Existing Graduate/4000 level courses

STS 4000. Senior seminar in Global Public Health
BUS 547. Energy Management.
OBC 505. Teaming and Organizing for Innovation.
OIE 542. Risk Management and Decision Analysis.
ME/AE 5105. Renewable Energy (2 credits)
SD 550. System Dynamics Foundation: Managing Complexity.
SD 551. Modeling and Experimental Analysis of Complex Problems.
SD 561. Energy and Environmental Dynamics.
SYS 501. Concepts of Systems Engineering.
SYS 540. Introduction to Systems Thinking.

PROPOSED GRADUATE ELECTIVE, DEPARTMENT OF INTEGRATIVE AND GLOBAL STUDIES

IGS 545 *Climate Change: Vulnerability and Mitigation* (Cat. II) 3 credits, Spring

Additional electives may be available; please consult the program directors to develop a course plan.

APPENDIX C: DECISION MATRIX AND CRITERIA FOR GQP SITE SELECTION

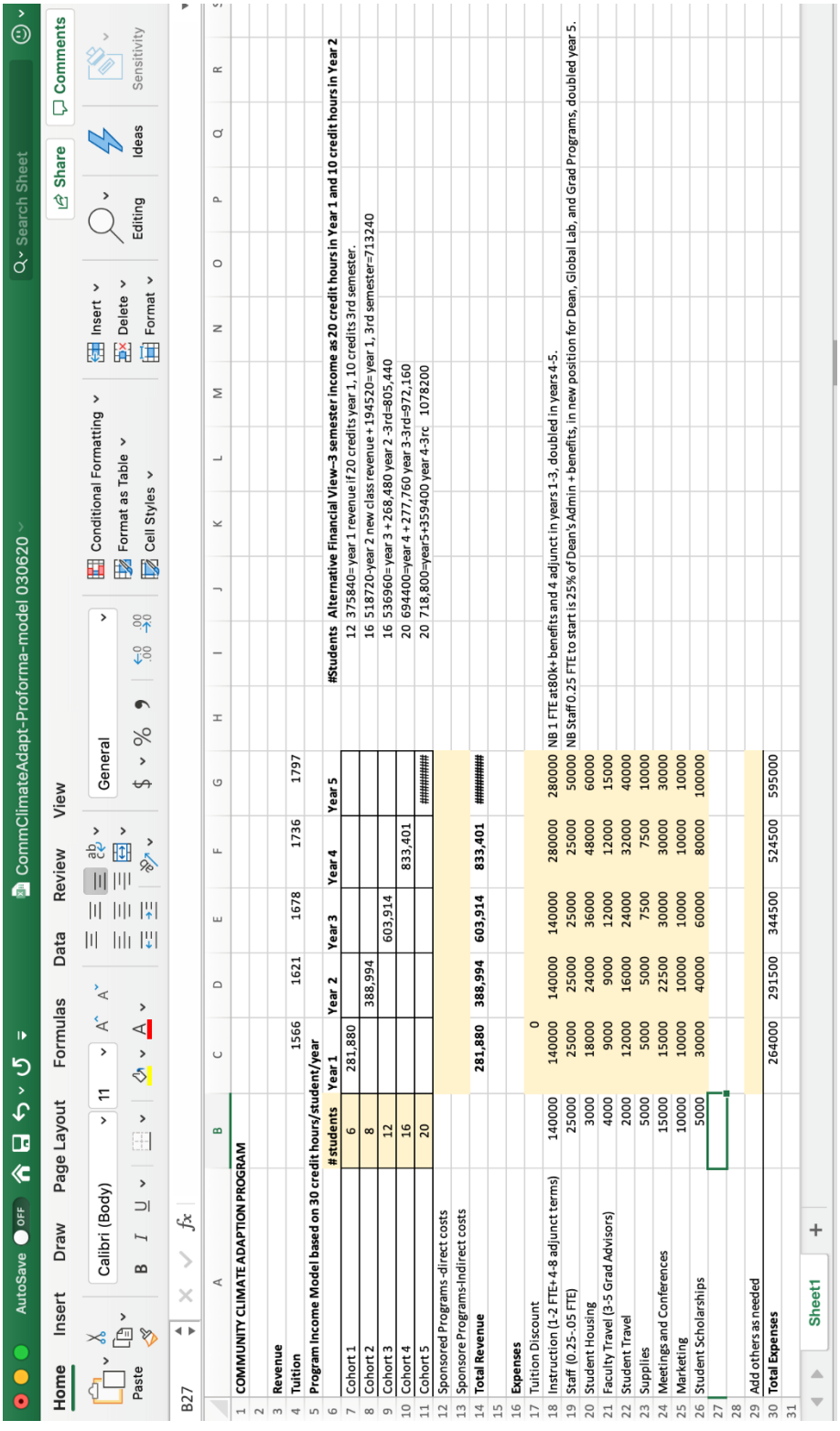
Location	Type	Relevance	University Support	Language	Faculty Expertise	Housing	Transportation	Affordability	Director Support	Terms Active	Additional notes (as appropriate)
Boston, Massachusetts	IQP									A	
Campinas, Brazil	MQP									flexible, traditionally C	Bioenergy and carbon capture
Cape Town, South Africa	IQP									B	
Cuenca, Ecuador	IQP									C & D	
Mandi, India	IQP									D - E	mountain ecologies/economies; Himalayan studies
Massachusetts (WROC)	IQP									D	Theme-based center with focus on water;
Melbourne, Australia	IQP									B,C,D	fire prone environment;
Paxton, Massachusetts	IQP									A and D	Sponsor would be excited!
Santa Fe, New Mexico	IQP									term B	the main issues re related to water scarcity
Sharjah, United Arab Emirat	IQP									B	Water & Energy
Tokyo, Japan	MQP									B-term MQP	Scholarships are available, we've been offered ~$400 per student at Shibaura Institute of Technology
Venice, Italy	IQP									B	Venice is on the front-line of climate change and will get instant worldwide attention
Wellington, New Zealand	IQP									C	we have local governmental agency contacts who often pay transportation costs in the country.
Worcester, Massachusetts	IQP									B, C, D, E	

Criteria:
1) No red
2) Must have full director support (green),
3) 0, 1, or 2 yellow criteria at a maximum. That means both CR and Namibia were taken out.

Green: 0-1 yellow criteria
Yellow: 2 yellow criteria
Orange: 3 yellow criteria

Criteria	Definition
Relevance	Relevance to the targeted degree program (Climate Change) Does the location have a specific importance to the topic? Green: High Importance/Relevance Yellow: Moderate Importance/Relevance Red: No or minimal Importance/Relevance
University Support	Local university partners to support research. Green: Current agreements/collaborations with local universities in place Yellow: Universities in the area, not currently in collaboration Red: No local universities
Language	Student and faculty language requirements to complete work Green: English is the primary language or there are sufficient English speakers that it would not inhibit research Yellow: English is not the primary language but, there are usually enougth students to speak the language (at a basic level) so translators are not needed Red: Students and faculty often rely on translators or others for communication
Faculty Expertise	WPI faculty expertise in the location and potential project topics Green: Known intrest of facutly in conducting research in this location Yellow: Potential faculty interest in conducting research in this location Red: Little to no interest in fauculty advising or conducting research in this location
Housing	The suitability and supply of local housing for students Green: Finding Student Housing is not an issue Yellow: There is limited student housing Red: It may be difficult to find housing for 2-3 additional students
Transportation	The quality of the local infrastructure to support student work Green: Public transporation or Taxis are extensive and affordable Yellow: There is public transportation or taxis but they are expensive Red: There is limited public transportation or taxi availability
Affordability	The overall avordability related to housing, food, transportation, and other costs. Green: The project center location is less expensive than the US Yellow: The project center location is cost about the same as the US Red: The project center location is more expensive than the US
Support	Center director support of having graduate students Green: Yes Yellow: Conditionally Red: Not at this point in time
Terms Offered	What terms does the project center currently run
Other	Additional Comments: Specifics for relevancy, Funding/Scholarship Opportunities, Any additional information you would like to add.

APPENDIX D: BUDGET PRO-FORMA, Sample Calculation



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	**COMMUNITY CLIMATE ADAPTION PROGRAM**																	
2																		
3	**Revenue**																	
4	**Tuition**		1566	1621	1678	1736	1797											
5	**Program Income Model based on 30 credit hours/student/year**																	
6		**# students**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**				**#Students**	**Alternative Financial View--3 semester income as 20 credit hours in Year 1 and 10 credit hours in Year 2**						
7	Cohort 1	6	281,880								12	375840=year 1 revenue if 20 credits year 1, 10 credits 3rd semester.						
8	Cohort 2	8		388,994							16	518720-year 2 new class revenue + 194520= year 1, 3rd semester=713240						
9	Cohort 3	12			603,914						16	536960= year 3 + 268,480 year 2 -3rd=805,440						
10	Cohort 4	16				833,401					20	694400=year 4 + 277,760 year 3-3rd=972,160						
11	Cohort 5	20					#########				20	718,800=year5+359400 year 4-3rc 1078200						
12	Sponsored Programs -direct costs																	
13	Sponsore Programs-Indirect costs																	
14	**Total Revenue**		**281,880**	**388,994**	**603,914**	**833,401**	#########											
15																		
16	**Expenses**																	
17	Tuition Discount		0															
18	Instruction (1-2 FTE= 4-8 adjunct terms)	140000	140000	140000	140000	280000	280000	NB 1 FTE at 80k+ benefits and 4 adjunct in years 1-3, doubled in years 4-5.										
19	Staff (0.25-.05 FTE)	25000	25000	25000	25000	25000	50000	NB Staff 0.25 FTE to start is 25% of Dean's Admin + benefits, in new position for Dean, Global Lab, and Grad Programs, doubled year 5.										
20	Student Housing	3000	18000	24000	36000	48000	60000											
21	Faculty Travel (3-5 Grad Advisors)	4000	9000	9000	12000	12000	15000											
22	Student Travel	2000	12000	16000	24000	32000	40000											
23	Supplies	5000	5000	5000	7500	7500	10000											
24	Meetings and Conferences	15000	15000	22500	30000	30000	30000											
25	Marketing	10000	10000	10000	10000	10000	10000											
26	Student Scholarships	5000	30000	40000	60000	80000	100000											
27																		
28																		
29	Add others as needed																	
30	**Total Expenses**		264000	291500	344500	524500	595000											
31																		

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Rolle, Chair)
Re: Motion to approve a new B.S./M.S. track for the M.S. in Community Climate Adaptation graduate degree program, (joint between the Department of Civil and Environmental Engineering in the School of Engineering and the Department of Integrative and Global Studies in the Global School).

Motion: The Committee on Graduate Studies and Research recommends and I move that a BS/MS track be added to the graduate program in Community Climate Adaptation (as described below) be established by the coordinated efforts of faculty from the above mentioned departments and schools. This represents an alternate track to the M.S. degree in Community Climate Adaptation.

The description of the M.S. and B.S./M.S. degree programs in Community Climate Adaptation to be included in the Graduate Catalog are provided below, followed by a rationale. This is a joint graduate program that will be administered by both DIGS and CEE.

Implementation Date for this action is Fall, 2021

Summary:

As the effects of global environmental change on local communities and surrounding regions become apparent, there is an urgent need to train professionals in the emergent field of climate adaptation (Moser, Coffee, and Selville 2017) in order to facilitate strategic action by local governments, businesses, and non-profits to achieve safe, thriving communities.

The professional Master's degree program in Community Climate Adaptation builds on WPI's distinctive interdisciplinary, project-based educational approach, making use of existing strengths, staff, and infrastructure to help expand student opportunities in the nascent, but rapidly growing, field of Climate Adaptation (in the previous paragraph, climate adaptation is not capitalized – but both sentences refer to the field of climate adaptation). This new graduate degree program brings together students from social science and technical backgrounds for sustained collaborative study, a radical departure from other offerings. CCA's innovative program structure supports our existing students for the BS/MS and MS options, while also inviting new kinds of graduate students to enroll.

Description of program for Graduate Catalog

The Community Climate Adaptation Master's program builds on WPI's distinctive interdisciplinary project-based approach, giving students training to support communities and organizations as they adapt to the impacts of a changing climate around the globe. Through this joint program between WPI's Department of Integrative and Global Studies and Department of Civil and Environmental Engineering, students can work with faculty across the university to gain collaborative and comparative perspectives on climate change adaptation strategies.

Program Rationale

In Massachusetts, the 2016 signing of Executive Order 569 by Governor Charlie Baker created an integrated climate change strategy for the Commonwealth, which has in turn invoked the development of a statewide hazard mitigation and climate adaptation plan. The same process has been underway around the country, as local and state governments recognize the need to take

action, and the severe weather, wildfires, and other climate-related problems of this summer have only underscored that need. Two thirds of American states, and communities from Miami to Houston, Anchorage to Kansas City, have all begun to plan how to protect their people and infrastructure from the impacts of climate change. Globally, locations as diverse as the Pacific Islands, mega-cities in Asia, and mountain communities in South America are confronting the critical need to adapt to our changing climate. This new Master's degree program can therefore help to satisfy a great and increasing need for expertise in community climate adaptation.

The program will implement the Graduate Global Projects Program (G^2P^2) framework (see Appendix A) for developing a professional project-based M.S. program that encourages the engagement of Global School faculty with faculty from other WPI departments and programs, exploring global "Grand Challenges" through study of a specific topical theme with global scope and local implications. This structure is ideal for collaborative, transdisciplinary, and joint programs with an anchor in both the Global School and another department or school, as the CCA program demonstrates. G^2P^2 is not a degree program itself, but an organizational structure that will help Global School/DIGS faculty train students to provide "Collaboration for a Better World," a theme that resonates throughout our program.

The framework builds on WPI's existing Global Projects Program infrastructure, which currently supports the undergraduate IQP and MQP experiences, to create high-impact Master's degree programs using existing sites and faculty to generate a graduate-level experience with breadth and depth across disciplines, sectors, and scales. Through substantive project-based learning experiences with diverse local partners in a 1.5 year master's degree program, our students will engage with a variety of themes that could range from climate action, global health, or energy systems, to international STS policy, environmental humanities, or collaborative management. By working in interdisciplinary teams across locations from Worcester to Wellington, Boston to Bangkok, WPI's Global School graduate students will develop comparative, collaborative, and holistic understandings of critical global problems, and they will be well-equipped to help solve them.

WPI's core interests, competencies, infrastructure, and reputation together infuse this new graduate degree program, offering a high reward, low risk strategy for Global School/DIGS success. Such a targeted interdisciplinary degree that includes both international and collaborative team-based training can position WPI well to seek funding, as well as creating specific giving opportunities for the WPI Capital Campaign. We expect that this focused degree program will provide great value for students though a unique participatory experience that is rarely found at the graduate level, as well as generating a strong foundation for faculty research and enhanced institutional impacts in the communities where we live and work.

WPI's Departments of Integrative & Global Studies (DIGS) and Civil & Environmental Engineering (CEE) together propose this initial offering, a collaborative M.S. degree (with a B.S./M.S. option) in Community Climate Adaptation that allows students to use their backgrounds in engineering, social sciences, and physical and biological sciences. The specific elements of this program are shown in Figure 1, below. The program uses a cohort-based structure that integrates students from technical and social science backgrounds into strong transdisciplinary teams working with an equally diverse group of faculty advisors to ensure effective engagement with real-world solutions. Upon beginning the program, students will be assigned to teams associated with one of WPI's more than fifty Project Centers; a local Massachusetts Project Center will always be included among the options. The specific site and process issues associated with their project will inform the entirety of their program, as well as

providing a comparative framework for the other teams. The team assignments will be based on a combination of factors related to their own skillset (foreign language, technical background, place-bound needs, etc.) and advisor/project center opportunities in a given year. In this way, we will capitalize on the synergistic strengths that individuals bring to the teams in technical and sociocultural arenas to create integrative project experiences that optimize use of the collective expertise of the team, rather than simply allowing team members to overlay basic content from their area of lesser expertise; the whole is indeed greater than the sum of the parts. The teams will learn that their capacity for problem-solving depends not on everyone bringing the "same" skillset to the table—however broad that might be—but rather on learning how to work together and with local communities to bring about positive impact.

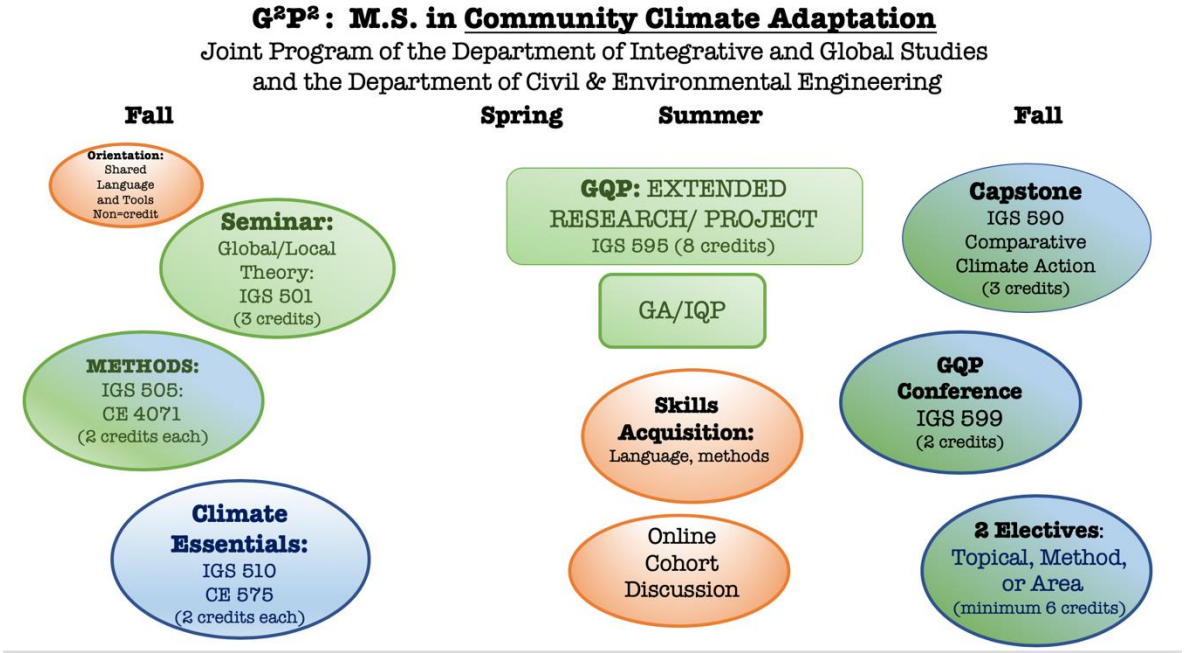


Figure 1: Proposed Master's Degree in Community Climate Adaptation

As depicted in Fig. 1, the program will include a non-credit orientation program during the first weeks of the initial semester of academic coursework. This integrative experience will help each new cohort develop a shared vocabulary and programmatic focus, as well as basic skills in teamwork and project management that they will be using throughout the program. Students will complete coursework in the three required areas of theory, method, and climate essentials in the first semester; if they complete courses in methods or climate essentials prior to admission to the CCA program, they may be able to instead choose an elective. There are 11 total credits in the first semester. The "Methods" required courses and the "Climate Essentials" courses are "split" courses that draw on expertise from both departments using the term structure to allow for two 2-credit courses to be paired for each of these requirements. This structure also allows more flexibility for the proposed B.S./M.S. program. The students will then spend four to six months at a Project Center, acquiring eight credits of project-based work. During that time, students will be in contact with their cohort and advisors (Online Cohort Discussions) to learn from one another, and will also develop skills appropriate to their research project (Skills Acquisition), such as learning additional research skills or studying foreign languages, which

may facilitate the completion of their site-based projects. Students will then return to campus for the final semester, when they will take a capstone seminar, two electives, and an additional team-based GQP conference (similar to "thesis credits" for the purpose of writing up the final project document), for a total of 11 credits. The total program is 30 credits. As part of the cohort seminars (Theory in the first semester and Capstone in the final semester), students will participate in the DIGS/Global School *Collaboration for a Better World* Seminar series, which will be open to the entire campus as well as the wider community.

Program Goals and Degree Objectives

The specific program emphasis on adaptation supports Master's graduates in acquiring theory and practice for climate adaptation jobs with NGOs, local/state governments, and other institutions or businesses. Today's communities must respond to actual and projected problems of infrastructure inadequacy; potential loss of land and economic assets; water resource and water quality impacts; differential health and social impacts; extreme weather events; coordination with multiple agencies; and compliance with local/state/federal policy decisions, as they navigate the environmental, policy, and built-environment constraints imposed by the reality of climate change. Addressing such problems will require innovative thinking about the both technical and social-economic-cultural dimensions of both problems and solutions. The degree objectives (provided below) can be fully achieved through participation in teams that include different kinds of expertise. Depending on a students' undergraduate background, graduates of the program could be on a path towards more technical careers, addressing climate adaptation through engineering solutions, or find employment as analysts, advocates, program managers, and community organizers. Broad goals for content and skill development are outlined below in three domains (see Fig. 2, below).

Understanding climate change impacts

- Characterize the ways that climate change and associated uncertainties impact food, energy, water, and social-ecological systems in specific localities
- Analyze the local challenges of adapting to climate change, including the ways that transition to a low-carbon economy influences global and regional development

Forging pathways to adaptation

- Demonstrate an ability to develop, implement, and monitor alternative solutions to climate adaptation that incorporate sociocultural, technical, economic, and ethical dimensions, as well as an appreciation for public-private collaboration and a multilevel governance approach.
- Promote an approach to transformative change that employs a community-based relational perspective as well as an understanding of technical feasibility to identify shared visions, values, ideas, and actions around adaptation and resilience

Partnering for and enacting community change

- Plan, design, and evaluate sustainable, low carbon, adaptive, resilient community-based solutions to problems associated with climate impacts and the built environment.
- Lead diverse groups of people in defining a shared adaptation action agenda, including agreed measures of progress and success, while building collaborative

adaptation and resilience policy and practice solutions that address social justice concerns.

Figure 2: Degree Objectives

Outcomes/Opportunities

Students completing this Master's program will develop approaches to solving problems, and address critical technical, cultural, socioeconomic, and policy issues related to climate change adaptation in unique communities. Our goal is to develop a range of opportunities for both students and faculty in ways that might leverage local sponsorship or grant-funded projects. The program is ideal for individuals with both technical and non-technical backgrounds who are looking to increase their skills and knowledge in relation to the multitude of interdisciplinary problems related to climate adaptation and mitigation such as water management, green energy transitions, community action plans for storm preparedness, and green building/retrofits for climate adaptation. In fact, the program is designed to integrate opportunities for learning and expanding knowledge of both technical and non-technical backgrounds, and we encourage students with a wide range of academic and practical experience to apply.

As we see more and more of these climate change impacts now and into the future, an increased demand for people with the kinds of skills and knowledge of the environmental and social issues that this program delivers will follow. Our distinctive project-based approach will help students gain hands-on experience and prepare them to work in the public, private, and non-profit sectors as experts in climate adaptation in ways that will compliment and extend their existing backgrounds and help them develop innovative approaches to solving critical climate related environmental and social problems. Job opportunities for our graduates include local and state governments, NGOs, and businesses preparing for a climate-impacted future, as well as local or regional branches of federal agencies such as USGS or USFS and state/national parks and historic monuments (Moser, Coffee, and Selville 2017).

Student Outcomes and Deliverables

In order to assess student growth and success in the program, we must design with the intention of what we see to be a "successful" graduate of the program. There are many ways to define success that are traditionally measured – metrics about job placement, passing a comprehensive exam, creation of a cumulative thesis paper – and we want to be sure the values and intentions of the program are being met by those criteria. Such assessment needs to take into account the unique and defining characteristics of WPI's education in project-based global learning, as well as the program's intent to nurture capable and informed citizen-leaders.

As stated above, the large-scale objectives for the program include partnering for and enacting community change, forging pathways to adaptation, and understanding climate change. If we design assessment with those in mind, the need for attitude/behavioral metrics, content mastery, and individual civic empowerment become key indicators of a program successfully completed. Metrics for those pieces would then include measurements/opportunities to test: content mastery (getting the information), critical reflection (making connections across knowledge, skills, attitudes, and one's identity as a climate change scholar), and knowledge curation (understanding the research process and developing skills to create and communicate knowledge).

To design for these many domains, we advocate for a developmental portfolio that will be created throughout the student's time pursuing the Master's. A digital portfolio manager –

which can be as basic as a multi-layered Wordpress website with articulated attributes, milestones or a dedicated ePortfolio system – can be used to track important milestones over time. Elements of this portfolio may include:

- Satisfaction of class assignments and passing grades in each course
- Individual depth competency papers/projects from the first and third semester cohort seminars
- A year-one team-based critical reflection designed to connect knowledge gained in the courses and GQP experiences
- Community evaluation and feedback related to project process and outcomes
- Participation in the GRIE Poster Competition at WPI or poster presentation off-campus
- Satisfactory completion of the GQP, team defense, and report
- A final summative critical reflection paper or presentation that articulates evidence of learning goals attained by the student teams (some of these will come from the program, some will be created by the students for their specific team GQP)

Comparison with Existing Programs and Market Analysis

This program is unique in its combination of interdisciplinary training with comparative and experiential learning at WPI sites around the globe. Per the market analysis, most graduate programs in climate change focus on policy and/or management, despite the great and growing need for climate adaptation. Increasingly, both communities and corporations are pledging carbon-neutrality and other forms of climate action, but there are few trained specialists to help them achieve these goals. We requested a analysis from WPI's market research team in Academic Affairs, and what follows here is a summary of that report, authored by Kyle McAlice.

There are three main areas that support the creation of a Master's program in Community Climate Action. First there is a growing job market for people with Master's in climate change and other related careers; second, the majority of Master's programs out there do not focus on the technical aspect of the degree, but instead center on policy and social considerations; and third, there is a history of funding for these kinds of programs.

Job Market

According to the Kaiser Family Foundation and the Washington Post (2018) there is a strong market for education relating to climate adaptation, and there is a projected growth of 11% (faster than average) in employment for 2016-2026 for Environmental Science and Specialties (BLS). One particular specialty experiencing major growth is that of a Climate Change Analyst, which has a projected growth of 12% (faster than average). A Master's degree is required in the Climate Change Analyst profession.

Degree Programs

There are currently 110 universities offering a graduate degree in Atmospheric Sciences, Meteorology, Climate Change, and Energy Policy in the United States; the majority of these, however, focus on the physical sciences. The report reviewed 25 that had a particular relevance to climate change. While all of them did require a capstone, internship, or time in the field, it is important to note that only two were engineering-degree based, and the majority of the niche climate change programs were focused on policy or management.

Funding

The report highlights that the National Science Foundation has a history of funding programs on climate change. It also notes that this might be an appropriate program for the Innovations in Graduate Education Grant (also from the NSF), which WPI has been awarded on two previous occasions. The NSF NRT grant would also match well with this program.

McAlice writes that "Industry expansion has shifted towards the catalysts of change from technical and interdisciplinary standpoints. That can be loosely defined as the scientific experts like climatologists, technical experts like engineers, and interdisciplinary change agents like climate change analysts, environmental scientists, and sustainability experts" (2020:7). Our interdisciplinary approach between the Global School and CEE seems well suited to meet this challenge.

The report suggests that Climate Change Adaptation could be offered as a concentration within existing or new degree programs. However, the report also notes an opportunity in the Climate Change education arena. Compared to other recent research efforts, there are far fewer degree opportunities related to the proposed program in Community Climate Adaptation. This provides an opportunity to enter a new market in a field that is widely known to be rapidly expanding. WPI has an opportunity to leverage vast experience with project work, and STEM expertise, in a field that is otherwise dominated by physical science and policy. Therefore, we believe that the time is right for a bold and innovative program focused on the integration of technological and social skills to support communities in addressing climate change impacts around the globe—with a name that clearly states the outcomes we aim to deliver.

Comparison to Existing Programs at WPI

WPI currently has no other graduate program that specifically focuses on climate change adaptation. The CCA program has been developed to complement rather than overlap the emerging Global School Master's programs, and to provide an opportunity for the Global School to work closely with the School of Engineering on a focused interdisciplinary degree.

Impact on Existing Programs at WPI

There has been considerable student interest in climate change coursework, as noted by the directors of the ENVS program, who conducted focus groups on campus to see if a climate track for the ENVS undergraduate program would be viable; they learned that students sought a BS/MS option as well as graduate training in this area (Stoddard and Elgert, personal communication).

Admissions Requirements for M.S. Degree (See Appendix B for full Graduate Catalog copy)

BA or BS degree in social science, environmental science/studies, physical sciences, biological sciences, engineering or other relevant field, with minimum 3.25 GPA

- A completed Application for Admission to Graduate Study.
- A non-refundable $70 application fee (waived for WPI alumni and matriculating WPI students).
- College transcripts in English and the original language from all accredited degree-granting institutions attended. Admitted students must provide official transcripts with an indication that the bachelor's degree has been awarded before they matriculate.

- Three letters of recommendation from individuals who can comment on the applicant's qualifications for pursuing graduate study in the chosen field. Applicants are required to invite their recommenders to submit letters through the online application only.
- Statement of purpose. This is a brief essay discussing background, interests, academic intent, and the reasons the applicant feels s/he would benefit from the program. The statement of purpose must be submitted electronically with the online application.

Anticipated 6-12 students in first two cohorts, increasing to 16-20 in subsequent years, with possibility of expanding to have both Fall and Spring semester cohort admissions as well as online opportunities for completion of stackable modules. These possible variations, however, are not addressed in this proposal.

Degree Requirements

The Community Climate Adaptation program requires three semesters plus summers to complete. Students will take a minimum of 30 credit hours, of which 10 credit hours will be the GQP. We expect to draw candidates with diverse academic backgrounds.

Once admitted, the students will participate in an online community-building program combined with an onsite orientation program in August, in order to facilitate a shared vocabulary and understanding and support a rapid start once the cohort begins their first semester.

To note: All of the proposed GS graduate programs will need to address the question of dual-listing of undergraduate/graduate courses, especially electives, to maximize the opportunities for dual degree programs.

Basic Academic Program:

Orientation: non-credit preparatory activities during first semester: shared language and basic skills
Semester 1: 11 credits in 3 Core Areas: Theory, Methods, and Climate Essentials
Semester 2 (plus optional summer/break): 8 credits of GQP
Semester 3: 11 credits:3 credits of Core Area (Comparative Climate Action Capstone), 2 credits of GQP, and minimum 6 credits of elective
TOTAL: 30 credits

Core Courses (11 credits in 1st semester; 3 credits in 3rd semester)

IGS 501	*Seminar: Theorizing Place, Community, and Global Environmental Change* - first semester (3 credits, new course, team taught by K. Foo or other core CCA-DIGS Faculty)
IGS 505	*Qualitative Methods for Community-Engaged Research* – A term (2 credits, new course, taught by core CCA- DIGS faculty)
CEE 4071	*Land Use, Development, and Controls* – B term (2 credits, existing course)
CEE 575	*Climate and the Earth System* – A term (2 credits, new course, taught by C. Eggleston); course supports possible Climate track in ENVS
IGS 510	*Human Dimensions of Global Environmental Change* – B term (2 credits, new course, taught by S. Strauss); course supports possible Climate track in ENVS degree program.
IGS 590	*Capstone Seminar: Comparative Climate Action* – final semester (3 credits, new course, team taught by core DIGS/CEE Faculty)

Collaboration for a Better World: Global School/DIGS Speaker Series— (non-credit but required)

GQP Credits

Total of 10 credits: IGS 595, 8 credits in 2nd semester of field placement at project center, with possible extension into summer. IGS 599, 2 credits of project work/writing in 3rd semester.

Elective Courses (minimum 6 credits: two courses each in 3rd semester, or in 1st if other requirements already met—see Appendix B).
Proposed elective: IGS 545 *Climate Change: Vulnerability and Mitigation* (Cat. II) 3 credits, Spring

In the future, more elective courses may be added from existing ENVS and other undergraduate classes; if that becomes possible, we will create dual-listed graduate sections and commensurate course requirements for these classes, including an additional hour of discussion each week, as well as different/additional readings and assignments. This strategy allows us to conserve teaching staff while adding depth to existing curricular options. The expectation is that the graduate degree program requires enrollment in 5XX level classes, but that this can be achieved without the obligation of creating entirely new courses or assigning new faculty. This challenge is shared by most of the proposed Global School graduate degree programs. We have, as noted, created one additional IGS elective for the program, which may also be of interest to students in the IDEaS program or other existing graduate programs. At this time, students interested in a graduate level independent study in environmental studies or environmental policy may request permission for participating in such opportunities.

GQP (second semester)

During the second semester, each GQP team (3-5 teams expected for a given cohort) will travel with an IQP group in first term and stay for a subsequent term into summer or winter break. Traveling with an IQP group addresses potential risk management issues with off-campus travel, and provides an opportunity for the graduate students and the IQP teams to interact, exchange ideas, and learn from one another. The graduate students will receive 8 credit hours for the entire period. Each graduate student will receive airfare and lodging to cover the cost of their travel. These funds are similar to the Global Scholarships provided to undergraduate students for IQPs, and supports the GQP as a programmatic guarantee for all students in the CCA program.

The graduate student teams will travel with an IQP group to a project center in Massachusetts or on other continents, and begin their own projects addressing a climate change-related action, while also helping undergraduates and advisors with their projects. Working in the field will provide critical challenges to the GQP team members' global competency. As a result, their understanding and knowledge of the relationship between climate change and implications for the local culture will be deeper and more nuanced than it would be were they not in the field. Building on the foundations of the online community established in the initial summer preparation/orientation, student/advisor discussion will continue, comparing the issues they are exploring in their local communities. In addition, students will have opportunities to deepen their knowledge of local language, history, water management or building practices, or other desired focus.

Participating Project Centers will vary depending on topic and advising assignments, but there will always be a local option for one team to be based in Massachusetts. The decision matrix for determining best available Project Center locations for graduate groups is attached (Appendix C). The intention behind this activity was to start a discussion around how to launch and scale the global project centers that support the proposed graduate student projects in climate change adaptation. We created a process to help us understand the best places to launch an initial cohort—and then identified the additional places to begin to scale these specific global projects. The criteria that were developed are "draft criteria." They were our best guesses at what would be important in making a decision on where to start and eventually where to expand, and will likely change.

Preliminary assessment suggests that Cuenca, Ecuador; Melbourne, Australia; possibly Mandi, India (requires D/E instead of C/D); Campinas, Brazil; and multiple Massachusetts locations would be good options for the initial cohort in this program. Possible additions for later cohorts include Venice, Italy; Cape Town, South Africa; and Sharjah, UAE.

Affiliated Departments

Department of Integrative and Global Studies – pending Faculty approval (DIGS)
Department of Civil and Environmental Engineering (CEE)

Faculty Contacts/Program Management

Sarah Strauss (Co-Director, DIGS Academic Programs Committee)
Jeanine Dudle (Co-Director, CEE Curriculum Committee)

Faculty (Instructors/Center Directors/Advisors)

DIGS: Strauss, Shockey, McCauley, Stanlick, Tuler, Pfeifer, Stoddard, Kurlanska, Rosbach, Doiron, Foo, Belz, Dodson, Davis
CEE: Bergendahl, Eggleston, Dudle, Mathisen, Abu-Lail, Walker, LePage
Other affiliated GS faculty according to interest (e.g., Elgert, San Martin, Hansen, Kreuger)

Resources Required

The program requires (a) 13 credit hours of new courses, (b) existing courses as electives, and (c) 3-5 additional advisors per cohort. We request one FTE faculty member to support the program, across DIGS/CEE, with the possibility of adding another in Year 5 if the numbers warrant. Some of the DIGS faculty have already been teaching many of the listed electives, so teaching loads in the new department might shift somewhat to include these content courses on load in DIGS, thereby serving multiple programs). Staffing for the program is estimated at 1.0 FTE for new TT faculty, adjunct faculty to teach 3-4 courses to allow existing faculty to teach content courses on load, and 0.25 FTE administrative assistance, with this coming in the person of the anticipated administrative hire to support the new Dean (1 FTE= 0.5 Dean Admin; 0.25 Global Lab; 0.25 Grad Programs). Assuming a minimal start of 8 graduate students in the first year, ramping up by 1 team/year, the program is self-sustaining, with possible net positive income of $112,000 to $573,000 annually over the five-year period. See Appendix D for more detailed funding model.

Funding, Research, and Development Opportunities

Faculty across the university with an existing interest in climate change research can become involved in supporting student projects around the world and at home, collecting pilot data for grant proposals as well as developing interdisciplinary research collaborations with our global partners. As climate adaptation often involves aspects of the built environment as well as environmental stewardship and remediation, there is great potential for synergy between this joint graduate program and the proposed CEE Center for the Built Environment. We anticipate opportunities to develop expertise for new research and educational opportunities in architectural engineering, for example, both through existing faculty and with possible future hires. We also expect that this program will generate and support new faculty and student research related to community climate adaptation that intersects well with a variety of other initiatives under exploration at WPI, ranging from global health to the material, management, and policy shifts critical for transitioning to a circular economy.

The DIGS Academic Programs Committee will seek outside support through the NSF NRT program (deadline Winter 2021) and other funding agencies, which would help enormously with both recruiting for and sustaining a new graduate program. Other grant opportunities may include the new Bezos Earth Fund, the NSF IRES (International Research Experience for Students), and more that are as yet unidentified. New kinds of Global School faculty fellowships might support advisors to go to particular centers and develop pilot research projects with students, to obtain sufficient data for writing a larger NSF or other grant proposal.

The G^2P^2 approach lends itself well to development opportunities in the WPI capital campaign. Alumni and other donors with specific interdisciplinary topical interests might choose to support graduate teams for climate adaptation in different locations, or to support a specific project center to increase capacity to add graduate student teams.

Program Assessment

This program makes use of existing faculty and infrastructure, as well as offering new opportunities for existing faculty, as well as new hires, to teach and research in new arenas. We will develop a process to monitor student and faculty outcomes and ensure sustainable growth of the program in the coming years. As the program is established, program outcomes will be articulated and a system will be established to evaluate the program relative to them. In addition, the evaluation system will include measures of the following: student satisfaction, post-graduation activities, student perceptions of quality of their experience, and faculty perceptions of program quality and opportunities to improve program quality and sustainability.

Implementation Date/Timeline

The proposed Community Climate Adaptation Program will advertise for admissions in 2020-21, and bring the first student cohort to campus in August of 2021.

AY 19-20	Program development
Summer 20/AY 20-21	Program Approval; Design and develop set of new core courses
AY 20-21	Develop web presence and marketing materials
AY 20-21	Recruit applicants and Admit new students
AY 21-22	First cohort arrives on campus, completes first year of program
AY 22-23	First cohort completes master's degree program (Fall 22)
AY 22-23	Evaluate Program, enhance /modify as appropriate

References

2017 Moser, Susanne, Joyce Coffee and Aleka Seville (2017) Rising to the Challenge, Together: A Review and Critical Assessment of the State of the US Climate Adaptation Field. A Report Prepared for the Kresge Foundation. https://kresge.org/content/rising-challenge-together

Resources for funding climate action GQPs:

Worcester: https://kresge.org/content/climate-resilience-and-urban-opportunity-0 and https://kresge.org/CCHE

Nantucket/Boston: https://www.mass.gov/service-details/coastal-resilience-grant-program

APPENDIX A: G^2P^2 Framework

Collaboration for a Better World: WPI's Graduate Global Projects Program (G^2P^2)

What

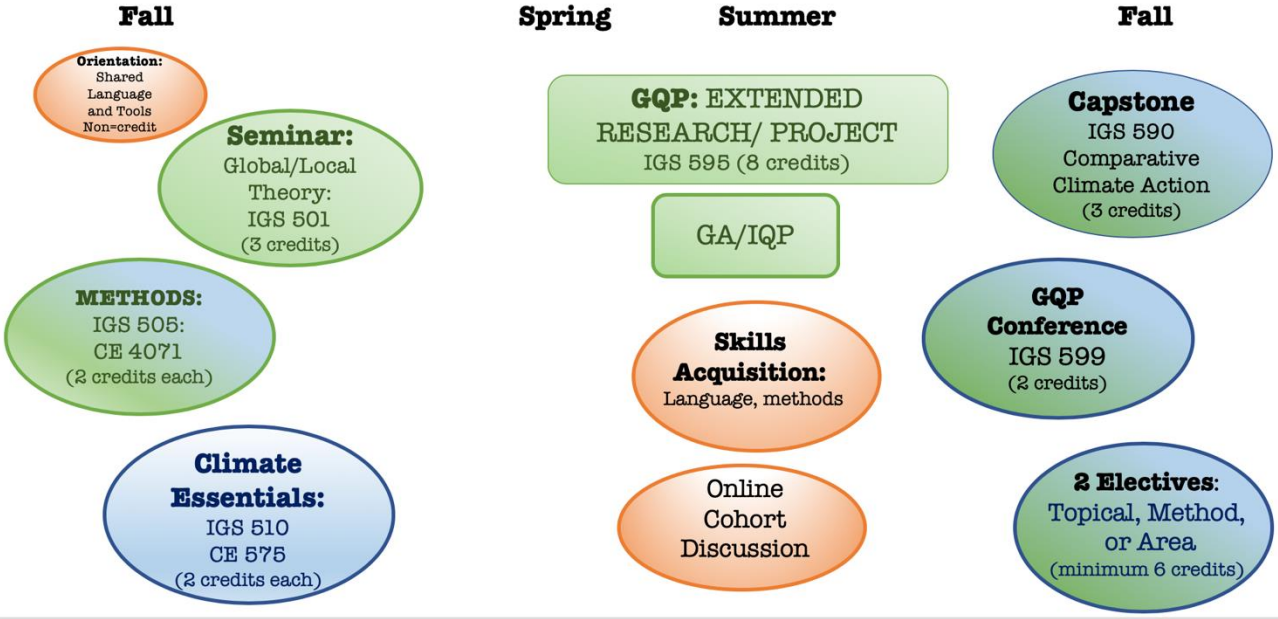
- Holistic project-based Master's program framework (option for WPI student 3.5 +1.5 BS/MS)
- Collaboration of GS and other departments/programs, depending on topical theme
- Modeled on Global Projects Program IQP infrastructure and philosophy, using existing sites and faculty to develop more intense graduate level experience across disciplines, sectors, and scales
- Extends PBL with diverse local partners, but engages deeply on one theme in critical areas: Collaboration, prep, time on project, cultural knowledge, breadth and depth, reflection = **"Impact"**

Why

- A great experience for students and strong foundation for faculty research and enhanced impacts.
- Flexible and scalable to diverse themes (GS Clusters, Grand Challenges, development, public health, STEM education, urban/rural planning, etc.) and partners (at WPI and elsewhere.)
- High reward, lower risk strategy for Global School success:
  - Builds on core WPI/GS interests, competencies, infrastructure, reputation
  - Resource efficient and highly marketable
  - Eligible for NSF funding, which would increase viability and visibility
  - Good target for Capital Campaign giving, for support of student projects and faculty research

G^2P^2 : M.S. in Community Climate Adaptation

Joint Program of the Department of Integrative and Global Studies and the Department of Civil & Environmental Engineering



Fundamentals of the MS degree program in Community Climate Adaptation

- 3 Semesters plus summers to completion: 30 course credits to degree, 10 of which are project-based. Cohorts could eventually start in August or January.
- MS track as well as 3.5 plus 1.5 B.S./M.S. for existing WPI students (can also dovetail with potential undergrad ENVS Climate track)
- First Semester: Students assigned to interdisciplinary teams of 4, and take courses in three required areas—Theory, Method, and Climate Change—for total of 11 credits. Non-Credit Orientation also required for "shared language" cohort-building activities, which includes skill building in teamwork and project management.
- Second Semester: Travel with an IQP group in first term, and stay in that location for subsequent term into summer or winter break. GA responsibilities for first term; 8 credits for entire period.
- Third Semester/final summer: Capstone seminar; 2 Electives; project conference credit: Total 11 credits.
- Degree based on both final team project and individual competency, with Group Project Defense and individual depth/competency papers or projects in Global/Local Theory and Capstone Seminars.
- Potential for eventual collaboration on various interdisciplinary topics: Climate, Social Justice, Health, Global Studies

APPENDIX B:
GRADUATE CATALOG COPY, COURSE PROPOSALS, AND POSSIBLE ELECTIVES

Graduate Catalog Copy:
Community Climate Adaptation

Faculty
S. Strauss, Director and Professor; Ph.D., University of Pennsylvania; energy, global environmental change, water and weather: risks, perceptions, and societal impacts, cultural conceptions of health and illness, transnational cultural processes and practices, mountain regions (Alps/Himalaya/Rockies), India, Switzerland, Scotland.

J. D. Dudle, Co-Director and Associate Professor; Ph.D., University of Massachusetts Amherst; surface water quality, drinking water treatment, public health.

L. Abu-Lail, Assistant Teaching Professor; Ph.D., Worcester Polytechnic Institute; unit operations of chemical engineering, water treatment, hydraulics, environmental organic chemistry.

M. Belz, Associate Teaching Professor, Ph.D. Kansas State University; cultural geography, architecture and development.

J. Bergendahl, Associate Professor; Ph.D., University of Connecticut; industrial and domestic wastewater treatment, particulate processes in the environment, chemical oxidation of contaminants.

J-M Davis, Assistant Teaching Professor; Ph.D., Memorial University of Newfoundland; geography.

J. Doiron, Assistant Teaching Professor; Ph.D., Boston University; higher education, leadership, innovation.

C. Eggleston, Professor & Department Head of Civil and Environmental Engineering; Ph.D., Stanford University; natural materials and how they interact with the environment in which we live, focusing on the fundamental processes of adsorption, dissolution/growth, electron transfer, and catalysis.

K. Foo, Assistant Teaching Professor; Ph.D., Clark University; urban geography, human-environment geography, landscape architecture.

C. B. Kurlanska, Assistant Teaching Professor, Ph.D., State University of New York at Albany; livelihood studies, community economy, social and solidarity economy, community development.

S. LePage, Instructor; M.S., Worcester Polytechnic Institute; urban and environmental planning, stormwater management, sustainable solutions to food, water and energy management.

P. P. Mathisen, Associate Professor; Ph.D., Massachusetts Institute of Technology; water resources and environmental fluid dynamics, contaminant fate and transport in groundwater and surface water, exchanges across the sediment-water interface.
S. McCauley, Associate Teaching Professor; Ph.D., Clark University; human-environment geography, urban geography, GIS.

G. Pfeifer, Associate Teaching Professor; Ph.D., University of South Florida; philosophy, social and political philosophy, global justice, and globalization.

D. Rosbach, Associate Teaching Professor; Ph.D., Virginia Tech; planning, governance and globalization.

I. Shockey, Associate Teaching Professor; Ph.D., Brandeis University; environmental sociology, climate change, ethnography

S. Stanlick, Assistant Professor; Ph.D., Lehigh University; learning sciences and technology, global citizenship

L. Stoddard, Associate Teaching Professor; Ph.D., Clark University; human-environment geography

S. Tuler, Associate Professor, Ph.D., Clark University; environmental science and policy, climate change

H. Walker, Schwaber Professor of Environmental Engineering, Ph.D., University of California, Irvine; water quality, emerging contaminants, water and wastewater treatment, environmental nanotechnology, membrane processes.

Program of Study
The Climate Change Adaptation (CCA) program offers graduate studies toward an M.S. degree, with the option for participating in the B.S./M.S. program. The CCA program builds on WPI's distinctive interdisciplinary project-based approach, giving students training to support communities and organizations as they adapt to the impacts of a changing climate around the globe. The program uses a cohort-based structure to integrate students from technical and social science background into transdisciplinary teams to gain collaborative and comparative perspectives on adaptation strategies. The program is designed to follow a full-time, cohort-based model, but limited flexibility exists to cover the coursework over a period of time longer than the prescribed 18 month model.

Admissions Requirements
Candidates for admission to the M.S. program must meet WPI's requirements, and are expected to have a bachelor's degree in social science, environmental studies/science, physical sciences, biological sciences, engineering, or other relevant field, with a minimum 3.25 GPA.

Degree Requirements

For the M.S. Community Climate Change Adaptation, the student is required to complete a minimum of 30 graduate credit hours. This includes a required non-credit orientation during the first semester. The Graduate Qualifying Project (GQP) provides a field-based experience to understand climate change impacts; forge pathways to adaptation; and enact community change. GQP's are carried out in cooperation with local partners and with the approval and oversight of faculty advisors. The program requirements are presented below.

Master of Science
Students pursuing an M.S. degree must complete a minimum of 30 graduate credit hours of work: 14 graduate credits of Core courses; 10 graduate credits hours of GQP; and 6 graduate credit hours of electives. Course and project requirements are detailed below.

1. Core Courses (14 graduate credits)

    IGS 501 Theorizing Place, Community, and Global Environmental Change (3 credits)
    IGS 505 Qualitative Methods for Community-Engaged Research (2 credits)
    CE 4071 Land Use, Development, and Controls (2 credits)
    CE 575 Climate and the Earth System (2 credits)
    IGS 510 Human Dimensions of Global Environmental Change (2 credits)
    IGS 590 Capstone Seminar: Comparative Climate Action (3 credits)

2. Graduate Qualifying Project (10 graduate credits)
    IGS 595 Graduate Qualifying Project Research (8 credits)
    IGS 599 Graduate Qualifying Project Conference (2 credits)

3. Elective Courses (minimum of 6 graduate credits)

    Elective courses may be chosen from the list of courses provided in the program handbook. Courses are selected based on personal interest and experience. Elective courses must be approved by the program committee prior to completion.

Combined Bachelor's/Master's Program
Students enrolled in the Bachelor's/Master's program must satisfy all the program requirements of their respective Bachelor's degree and all of the program requirements of the Master's degree in Climate Change Adaptation. A maximum of four courses may be counted toward both the undergraduate and graduate degrees. Double-counted graduate credits must be in courses, and cannot be in qualifying project work. A maximum of six graduate credits may be double-counted in Elective Courses and a maximum of six graduate credits may be double counted in Core courses. Elective courses must be at the 4000-level or above. Completion of Core courses must be pre-approved by the program because of the cohort nature of the graduate degree. A grade of B or better is required for any course to be counted toward both degrees. Acceptance into the Bachelor's/Master's program means that the candidate is qualified for graduate school, and signifies approval of the graduate credits listed for credit toward both the undergraduate and graduate degrees.

Global Project Centers

The WPI Global Projects Program allows WPI students to immerse themselves in new cultures and tackle unstructured problems in ways that are meaningful to local communities. The WPI Global Projects Program includes a diverse array of project locations in over 31 countries throughout the world. The project locations range from large international cities to small mountainside villages, and these sites serve as host locations for the GQP in the CCA program.

Course Descriptions for Core Classes (Proposed New)

IGS 501 *Theorizing Place, Community, and Global Environmental Change* (Cat. I) 3 credits, Fall term.
This proseminar explores the relationship between global and local contexts at different scales, with a focus on how communities can change and thrive under conditions of global environmental change. We explore the theoretical and practical understandings of, and strategies for, cultural and technological change as enacted in specific places by people whose identities, practices, and values vary widely, and who are impacted differentially by the historical, structural, and environmental conditions that they both create and encounter. Students will complete an individual depth assignment that could be a substantive research paper, project proposal, or community service activity for the degree portfolio. They will also participate in the DIGS/Global School Speaker Series, and will use that content to engage with course readings as well as their own projects.

IGS 505 *Qualitative Methods for Community-Engaged Research* (Cat. I) A, 2 credits
This course advances student knowledge of research design and methods, emphasizing frameworks, strategies, and qualitative methods for community-engaged studies. In this course, students engage with alternative frameworks, including community based (participatory) research and citizen science, to build understandings about the continuum of the research process. Process elements include planning and design, implementation, evaluation, dissemination, and assessing policy implications, as they are applied in deeply collaborative action research settings. This course explores strengths, weaknesses, and challenges of different data gathering and analytic methods through exploration of prior studies, and considers how these research approaches intersect with social, cultural, and institutional practices and ethical standards. Students work in teams to develop proposals for a Graduate Qualifying Project that addresses the needs of an outside project partner.

IGS 510 *Human Dimensions of Global Environmental Change.* (Cat. I). 2 credits, B term
This course provides the groundwork for understanding the historical, sociocultural, and political-economic impacts of climate change in the Anthropocene. Building upon a basic understanding of climate science, this course addresses how global environmental change is mediated by social, political, economic and cultural systems. Case studies are used to scrutinize how efforts to mitigate and adapt to impacts can overcome or exacerbate existing inequities. Through a focus on how responses emerge in specific places and times, students explore how they can play a role in efforts by communities around the world as these communities adapt to existing and developing environmental changes, face decisions about retreat, and plan for the future.

IGS 545 *Climate Change: Vulnerability and Mitigation* (Cat. II) 3 credits, Spring
Taking climate change as a starting point, this course introduces students to a wide range of climate change conditions, human responses to those conditions, and points toward the need for deeper understanding of human-environment relationships. The course will draw from Geography, Economics, Global Environmental Change, and other cross cutting disciplines for theory and case studies. Examples of climate change risks and mitigation efforts will come from the developed and developing world and will include both urban and rural examples. Assessment techniques include small group projects, case-based testing, and in class and online discussions.

IGS 590 *Capstone Seminar: Comparative Climate Action*. (Cat. I). 3 credits, Fall
This seminar analyzes core themes of the Community Climate Adaptation Program during the students' third and final semester. Bridging the disciplines of geography, anthropology, and civil & environmental engineering, we draw together the insights and experiences learned by technical and social science students during the first two semesters of the program. Through a combination of readings, case studies, and an individual depth project, the course provides an opportunity for students to revisit theoretical frameworks for climate adaptation strategies in a way that is informed by their place-based applied research in diverse places internationally. We explore similarities and differences observed in different localities across scales in order to strengthen an empirically-grounded, comparative, and holistic analysis of community climate adaptation. In doing so, we investigate both positive resonances between theoretical frameworks and demonstrated outcomes in discrete places, while we also critically probe any gaps, tensions, and surprises that may emerge from the GQP fieldwork. Participation in the DIGS/GS speaker series is required for this course, as the topics and guests will provide additional content for consideration.

IGS 595 *Graduate Qualifying Project Research* (Cat I) Spring, 3-8 credits
The eight-credit graduate qualifying project (GQP), typically done in in teams, is to be carried out in cooperation with an external partner, and it is overseen by two faculty members representing both the Department of Integrated and Global Studies and Civil & Environmental Engineering. Student teams seek to answer a climate adaptation question identified and explained by the external partner. The student teams conduct applied research using goals, objectives, and methods developed in the core Methods courses for the CCA program, based on this driving question and under the joint guidance of two WPI faculty advisors and the external partner. The course is full-time and structured by two weekly meetings with the faculty advisors and external partner. Professional development skills, such as oral and written communication, teamwork, leadership, and collaborative problem-solving will be practiced as the research is completed across a full semester.

IGS 599 *Graduate Qualifying Project Conference* (Cat I) Fall, 1-3 credits
The graduate qualifying project (GQP), typically done in in teams, is to be carried out in cooperation with a sponsor or external partner, and it is overseen by two faculty members representing both the Department of Integrated and Global Studies and Civil & Environmental Engineering. This three-credit Conference course integrates theory and practice of community climate adaptation strategies, and it should address and build upon the frameworks and tools acquired in the research phase of the program. Deliverables for this course consist of a written report and public presentation to the WPI community and external partner.

CE 575 *Climate and the Earth System* (Cat. I.) 2 credits, A term
This course deals with the Earth's operation as a system, covering its energy budget along with its interacting atmosphere, ocean, biosphere and geologic systems. By showing how all systems work together to form feedback loops that can amplify or counteract input perturbations and forcings of the overall system, the course illustrates how these systems modulate and control our planet's climate system. Throughout, an Anthropocene point of view is taken to study not only "natural" systems but also the ways in which human societies interact with and are an integral part of the Earth system. The course integrates physical, chemical, and biological basics to arrive at an understanding of complex natural and human systems.

CEE ELECTIVES

CE 4061. Hydrology (**Mathisen**)
CE 402X Resilient Infrastructure for a Changing Climate (**Mallick**)
CE/CHE 4063. Transport & Transformations in the Environment **(Kmiotek, CHE)**
CE 542. Geohydrology. **(Mathisen)**
CE 560. Advanced Principles of Water Treatment. **(Dudle)**
CE 561. Advanced Principles of Wastewater Treatment. **(Walker)**
CE 562. Biosystems in Environmental Engineering. **(Abu-Lail)**
CE 563. Industrial Waste Treatment (**Bergendahl**)
CE 565. Surface Water Quality Modeling. **(Dudle)**
CE 566. Groundwater Flow and Pollution (**Mathisen**)
CE 567. Hazardous Waste: Containment, Treatment and Prevention (**Bergendahl**)
CE 570. Contaminant Fate and Transport (**Mathisen**)
CE 571 Water Chemistry **(Dudle)**
CE 572. Physical and Chemical Treatment (**Bergendahl**)
CE 573. Treatment System Hydraulics (**Bergendahl**)
CE 574. Water Resources Management **(Mathisen)**

GLOBAL STUDIES, SOCIAL SCIENCE, BUSINESS, AND OTHER ELECTIVES
Existing Graduate/4000 level courses

STS 4000. Senior seminar in Global Public Health
BUS 547. Energy Management.
OBC 505. Teaming and Organizing for Innovation.
OIE 542. Risk Management and Decision Analysis.
ME/AE 5105. Renewable Energy (2 credits)
SD 550. System Dynamics Foundation: Managing Complexity.
SD 551. Modeling and Experimental Analysis of Complex Problems.
SD 561. Energy and Environmental Dynamics.
SYS 501. Concepts of Systems Engineering.
SYS 540. Introduction to Systems Thinking.

PROPOSED GRADUATE ELECTIVE, DEPARTMENT OF INTEGRATIVE AND GLOBAL STUDIES

IGS 545 *Climate Change: Vulnerability and Mitigation* (Cat. II) 3 credits, Spring

Additional electives may be available; please consult the program directors to develop a course plan.

APPENDIX C:
DECISION MATRIX AND CRITERIA FOR GQP SITE SELECTION

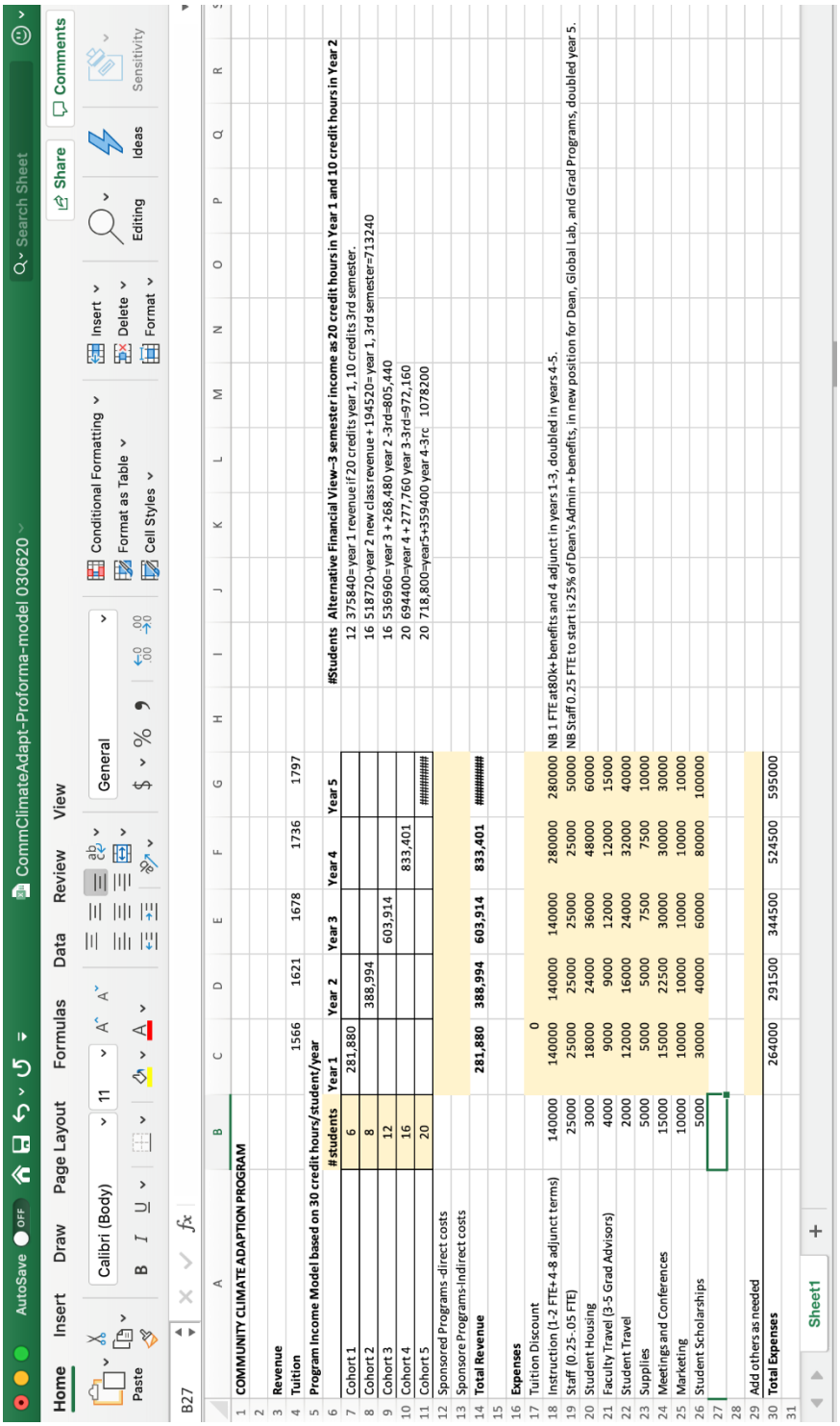
Location	Type	Relevance	University Support	Language	Faculty Expertise	Housing	Transportation	Affordability	Director Support	Terms Active	Additional notes (as appropriate)
Boston, Massachusetts	IQP									A	
Campinas, Brazil	MQP									flexible, traditionally C	Bioenergy and carbon capture
Cape Town, South Africa	IQP									B	
Cuenca, Ecuador	IQP									C & D	
Mandi, India	IQP									D - E	mountain ecologies/economies; Himalayan studies
Massachusetts (WROC)	IQP									D	Theme-based center with focus on water;
Melbourne, Australia	IQP									B,C,D	fire prone environment;
Paxton, Massachusetts	IQP									A and D	Sponsor would be excited!
Santa Fe, New Mexico	IQP									term B	the main issues re related to water scarcity
Sharjah, United Arab Emirati	IQP									B	Water & Energy
Tokyo, Japan	MQP									B-term MQP	Scholarships are available, we've been offered ~$400 per student at Shibaura Institute of Technology
Venice, Italy	IQP									B	Venice is on the front-line of climate change and will get instant worldwide attention
Wellington, New Zealand	IQP									C	we have local governmental agency contacts who often pay transportation costs in the country.
Worcester, Massachusetts	IQP									B, C, D, E	

Criteria:
1) No red
2) Must have full director support (green),
3) 0, 1, or 2 yellow criteria at a maximum. That means both CR and Namibia were taken out.

Green: 0-1 yellow criteria
Yellow: 2 yellow criteria
Orange: 3 yellow criteria

Criteria	Definition
Relevance	Relevance to the targeted degree program (Climate Change) Does the location have a specific importance to the topic? Green: High Importance/Relevance Yellow: Moderate Importance/Relevance Red: No or minimal Importance/Relevance
University Support	Local university partners to support research. Green: Current agreements/collaborations with local universities in place Yellow: Universities in the area, not currently in collaboration Red: No local universities
Language	Student and faculty language requirements to complete work Green: English is the primary language or there are sufficient English speakers that it would not inhibit research Yellow: English is not the primary language but, there are usually enougth students to speak the language (at a basic level) so translators are not needed Red: Students and faculty often rely on translators or others for communication
Faculty Expertise	WPI faculty expertise in the location and potential project topics Green: Known intrest of facutly in conducting research in this location Yellow: Potential faculty interest in conducting research in this location Red: Little to no interest in fauculty advising or conducting research in this location
Housing	The suitability and supply of local housing for students Green: Finding Student Housing is not an issue Yellow: There is limited student housing Red: It may be difficult to find housing for 2-3 additional students
Transportation	The quality of the local infrastructure to support student work Green: Public transporation or Taxis are extensive and affordable Yellow: There is public transportation or taxis but they are expensive Red: There is limited public transportation or taxi availability
Affordability	The overall avordability related to housing, food, transportation, and other costs. Green: The project center location is less expensive than the US Yellow: The project center location is cost about the same as the US Red: The project center location is more expensive than the US
Support	Center director support of having graduate students Green: Yes Yellow: Conditionally Red: Not at this point in time
Terms Offered	What terms does the project center currently run
Other	Additional Comments: Specifics for relevancy, Funding/Scholarship Opportunities, Any additional information you would like to add.

APPENDIX D: BUDGET PRO-FORMA, Sample Calculation



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	**COMMUNITY CLIMATE ADAPTION PROGRAM**																	
2																		
3	**Revenue**																	
4	**Tuition**		1566	1621	1678	1736	1797											
5	**Program Income Model based on 30 credit hours/student/year**																	
6		**# students**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**											
7	Cohort 1	6	281,880															
8	Cohort 2	8		388,994														
9	Cohort 3	12			603,914													
10	Cohort 4	16				833,401												
11	Cohort 5	20					########											
12	Sponsored Programs -direct costs																	
13	Sponsore Programs-indirect costs																	
14	**Total Revenue**		**281,880**	**388,994**	**603,914**	**833,401**	########											
15																		
16	**Expenses**																	
17	Tuition Discount		0															
18	Instruction (1-2 FTE+ 4-8 adjunct terms)	140000	140000	140000	140000	280000	280000											
19	Staff (0.25-.05 FTE)	25000	25000	25000	25000	25000	50000											
20	Student Housing	3000	18000	24000	36000	48000	60000											
21	Faculty Travel (3-5 Grad Advisors)	4000	9000	9000	12000	12000	15000											
22	Student Travel	2000	12000	16000	24000	32000	40000											
23	Supplies	5000	5000	5000	7500	7500	10000											
24	Meetings and Conferences	15000	15000	22500	30000	30000	30000											
25	Marketing	10000	10000	10000	10000	10000	10000											
26	Student Scholarships	5000	30000	40000	60000	80000	100000											
27																		
28																		
29	Add others as needed																	
30	**Total Expenses**		264000	291500	344500	524500	595000											
31																		

NB 1 FTE at80k+ benefits and 4 adjunct in years 1-3, doubled in years 4-5.
NB Staff 0.25 FTE to start is 25% of Dean's Admin + benefits, in new position for Dean, Global Lab, and Grad Programs, doubled year 5.

#Students Alternative Financial View–3 semester income as 20 credit hours in Year 1 and 10 credit hours in Year 2

12 375840= year 1 revenue if 20 credits year 1, 10 credits 3rd semester.
16 518720-year 2 new class revenue + 194520= year 1, 3rd semester=713240
16 536960= year 3 + 268,480 year 2 -3rd=805,440
20 694400=year 4 + 277,760 year 3-3rd=972,160
20 718,800=year5+359400 year 4-3rc 1078200

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Rolle, Chair)
Re: Motion to add IGS designation for graduate credit for CCA Master's Program

Motion: Committee on Graduate Studies and Research recommends and I move, that the IGS designation be added to the Course Catalog for graduate credit.

Rationale: This new designation supports the creation of academic courses and degree programs within the Department of Integrative and Global Studies. It was approved by the DIGS Academic Programs Committee on 7 September 2020 (the DIGS department not yet being approved as a voting entity).

Implementation Date for this action is Fall, 2021

Resource Needs: None

Impact on Distribution Requirements and Other Courses: None

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Rolle, Chair)
Re: New Course Proposal
IGS 599: *Graduate Qualifying Project Conference (*Cat. I) 3 credits, Fall

Motion: The Committee on Graduate Studies and Research recommends, and I move, that IGS 599, as described below, be added.

Course/Catalog Description: IGS 599 Graduate Qualifying Project Conference
The graduate qualifying project (GQP), typically done in teams, is to be carried out in cooperation with a sponsor or external partner, and it is overseen by two faculty members representing both the Department of Integrated and Global Studies and Civil & Environmental Engineering. This three-credit Conference course integrates theory and practice of community climate adaptation strategies, and it should address and build upon the frameworks and tools acquired in the research phase of the program. Deliverables for this course consist of a written report and public presentation to the WPI community and external partner.

Prerequisite: IGS 599 Graduate Qualifying Project: Conference

Recommended background: Completion of IGS 595.

Anticipated instructors: Team taught by any CCA core faculty from DIGS and CEE

Rationale
This three-credit Conference course provides the opportunity to apply theoretical frameworks of community climate adaptation to data collected in IGS 595, a full-time, team-based, applied research project with an external partner.

Implementation Date: It is expected that this course will be offered in 2022 Fall.

Resource Needs:
- This is a new graduate course and will be part of the normal load.
- Classroom/Zoom space for 12-15 people
- Laboratory: N/A
- Library resources: N/A
- Information Technology: N/A

Impact on Distribution Requirements and Other Courses: None

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Prof. Rolle, Chair)
Re: New Course Proposal
IGS 595: *Graduate Qualifying Project Research (*Cat. I) 8 credits, Spring

Motion: The Committee on Graduate Studies and Research recommends, and I move, that IGS 595, as described below, be added.

Course/Catalog Description: IGS 595 Graduate Qualifying Project: Research
The eight-credit graduate qualifying project (GQP), typically done in in teams, is to be carried out in cooperation with an external partner, and it is overseen by two faculty members representing both the Department of Integrated and Global Studies and Civil & Environmental Engineering. Student teams seek to answer a climate adaptation question identified and explained by the external partner. The student teams conduct applied research using goals, objectives, and methods developed in the core Methods courses for the CCA program, based on this driving question and under the joint guidance of two WPI faculty advisors and the external partner. The course is full-time and structured by two weekly meetings with the faculty advisors and external partner. Professional development skills, such as oral and written communication, teamwork, leadership, and collaborative problem-solving will be practiced as the research is completed across a full semester.

Recommended background: Completion of CCA core classes (except IGS 590 and IGS 599) and permission of instructor.

Anticipated instructors: Team taught by any CCA core faculty from DIGS and CEE

Rationale
This eight-credit Research course provides the opportunity to conduct place-based applied research using WPI's signature approach to interdisciplinary project-based learning in collaborative teams. The work completed through the GQP experience is at the heart of this degree program in Community Climate Adaptation, allowing students to acquire real-world experience in the completion of their degree program, built on a transdisciplinary skillset developed in the first part of the program, and fully developed and analyzed in a comparative framework with other cohort projects in the final portion of the program.

Implementation Date: It is expected that this course will be offered in 2022 Spring

Resource Needs:
- This is a new graduate course and will be part of the normal load.
- Classroom/Zoom space for 12-15 people
- Laboratory: N/A
- Library resources: N/A
- Information Technology: N/A

Impact on Distribution Requirements and Other Courses: None

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Rolle, Chair)
Re: New Course Proposal—
IGS 590 *Capstone Seminar: Comparative Climate Action*.

Motion: The Committee on Graduate Studies and Research recommends, and I move, that IGS 590 as described below, be added.

Course/Catalog Description: IGS 590 (Cat. I). 3 credits, offered in Fall semester
Capstone Seminar: Comparative Climate Action. IGS 590 (Cat. I). 3 credits
(new course)

This seminar analyzes core themes of the Community Climate Adaptation Program during the students' third and final semester. Bridging the disciplines of geography, anthropology, and civil & environmental engineering, we draw together the insights and experiences learned by technical and social science students during the first two semesters of the program. Through a combination of readings, case studies, and an individual depth project, the course provides an opportunity for students to revisit theoretical frameworks for climate adaptation strategies in a way that is informed by their place-based applied research in diverse places internationally. We explore similarities and differences observed in different localities across scales in order to strengthen an empirically-grounded, comparative, and holistic analysis of community climate adaptation. In doing so, we investigate both positive resonances between theoretical frameworks and demonstrated outcomes in discrete places, while we also critically probe any gaps, tensions, and surprises that may emerge from the GQP fieldwork. Participation in the DIGS/GS speaker series is required for this course, as the topics and guests will provide additional content for consideration.

Recommended background: Completion of *12 credits in 3 Core CCA courses and 8 credits of GQP*.

Anticipated instructors: Course to be team taught by a combination of DIGS and CEE Faculty

Rationale: This is a core course in the proposed graduate program in Community Climate Adaptation. As a capstone seminar, team-taught by DIGS and CEE faculty, it plays an integral role in bringing the cohort, composed of technical and social science students, back together to develop collaborative and comparative insights on climate adaptation. In particular, it will engage transdisciplinary coursework across the cohort, while it integrates the GQP into a theoretically and practically informed holistic framework guiding community adaptation to climate change.

Implementation Date: Fall, 2022.

Resource Needs:
Please summarize basic resources needed to deliver this course, including the following:
- This is a new graduate course that is part of the normal load.

- Classroom/Zoom space for 12-15 people
- Laboratory: N/A
- Library resources: N/A
- Information Technology: N/A

Impact on Distribution Requirements and Other Courses: None

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Prof. Rolle, Chair)
Re: New Course Proposal
IGS 510 *Human Dimensions of Global Environmental Change*

Motion: The Committee on Graduate Studies and Research recommends, and I move, that IGS 510 as described below, be added.

Course/Catalog Description: IGS 510 (Cat. I). 2 credits, offered in B term
This course provides the groundwork for understanding the historical, sociocultural, and political-economic impacts of climate change in the Anthropocene. Here, we assume basic understanding of climate science, and move on to address how these impacts are mediated by social, political, economic and cultural systems. Case studies are used to scrutinize how efforts to mitigate and adapt to impacts, similarly mediated by the same social, political, economic and cultural systems, can overcome or exacerbate existing inequities. Through a focus on how impacts and responses emerge in specific places and times we engage students in an exploration of how they can play a role in efforts by communities around the world that are adapting to the environmental changes they are already experiencing, facing decisions about retreat, and planning for the future.

Recommended background: Admission to the CCA MS or BS/MS program, as well as CE 575, or another course in climate science, or permission of instructor.
Anticipated Instructor: Sarah Strauss or other DIGS faculty (multiple qualified)

Rationale: This is a 2-credit core course in the proposed graduate program in Community Climate Adaptation. It complements the Climate Change and the Earth System course (also 2-credits) on the science of anthropogenic climate change, introducing the various human dimensions of this wicked problem—sociocultural, historical, ethical, political-economic, and institutional--as they differentially impact human communities around the world. Together, these two courses will provide a 4 credit grounding for the interdisciplinary team projects undertaken in the second semester of this graduate program. The course could also be offered to undergraduates taking the proposed climate change track in the ENVS degree program, or to other interested graduate or undergraduate students.

Implementation Date: It is expected that this course will be offered in B term of 2021, and is designed to follow CE 575, which will be offered in A-term

Resource Needs:
Please summarize basic resources needed to deliver this course, including the following:
- This is a new graduate course that is part of the normal load for Sarah Strauss.
- Classroom/Zoom space for 15 people to start; may increase over time.
- Laboratory: N/A
- Library resources: N/A
- Information Technology: N/A

Impact on Distribution Requirements and Other Courses: None

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Prof. Rolle, Chair)
Re: New Course Proposal
IGS 505: *Qualitative Methods for Community-Engaged Research*

Motion: The Committee on Graduate Studies and Research recommends, and I move, that IGS 505 as described below, be added.

Course/Catalog Description: IGS 505 (Cat. I). (2 credits)
This course advances student knowledge of research design and methods, emphasizing frameworks, strategies, and qualitative methods for community-engaged studies. In this course, students engage with alternative frameworks, including community based (participatory) research and citizen science, to build understandings about the continuum of the research process. Process elements include planning and design, implementation, evaluation, dissemination, and assessing policy implications, as they are applied in deeply collaborative action research settings. This course explores strengths, weaknesses, and challenges of different data gathering and analytic methods through exploration of prior studies, and considers how these research approaches intersect with social, cultural, and institutional practices and ethical standards. Students work in teams to develop proposals for a Graduate Qualifying Project that addresses the needs of an outside project partner.

Recommended background: Admission to the CCA MS program, completion of social science research methods course (e.g., ID2050 or equivalent), or permission of instructor.

Anticipated instructors: Any CCA core faculty from DIGS

Rationale: This is a core course in the proposed graduate program in Community Climate Adaptation. It is designed to provide advanced knowledge and skills of design and conduct of social science research for projects that engage communities in partnerships and with attention to equity and power. It will play an integral role in supporting teams composed of technical and social science students to design and conduct ethically informed research on climate adaptation in partnership with community members and other stakeholders.

Implementation Date: It is expected that this course will be offered in 2021 A.
Resource Needs:
Please summarize basic resources needed to deliver this course, including the following:

- This is a new graduate course and will be part of the normal load.
- Classroom/Zoom space for 12-15 people
- Laboratory: N/A
- Library resources: N/A
- Information Technology: N/A

Impact on Distribution Requirements and Other Courses: None

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Rolle, Chair)
Re: New Course Proposal
IGS 501: Theorizing Place, Community, and Global Environmental Change

Motion: The Committee on Graduate Studies and Research recommends, and I move, that IGS 501 as described below, be added.

Course/Catalog Description: IGS 501 (Cat. I). 3 credits
This proseminar explores the relationship between global and local contexts at different scales, with a focus on how communities can change and thrive under conditions of global environmental change. We explore the theoretical and practical understandings of, and strategies for, cultural and technological change as enacted in specific places by people whose identities, practices, and values vary widely, and who are impacted differentially by the historical, structural, and environmental conditions that they both create and encounter. Students will complete an individual depth assignment that could be a substantive research paper, project proposal, or community service activity for the degree portfolio. They will also participate in the DIGS/Global School Speaker Series, and will use that content to engage with course readings as well as their own projects.

Recommended background: Admission to the CCA program, MS or BS/MS track.

Anticipated Instructor: Katherine Foo or other CCA core faculty from DIGS

Rationale: This is a core course in the proposed graduate program in Community Climate Adaptation. Starting from a basis in the core disciplines of Anthropology and Geography and taking insights from a wide range of transdisciplinary approaches, our holistic, comparative, and place-based perspective offers a grounded approach to community engagement. It will provide a framework for understanding the theoretical and practical elements of community adaptation to climate change, including broader connections between local communities, their environmental resources, and the wider global context.

Implementation Date: It is expected that this course will be offered in Fall, 2021.

Resource Needs:
Please summarize basic resources needed to deliver this course, including the following:
- This is a new graduate course and it will be part of the normal load.
- Classroom/Zoom space for 12 people
- Laboratory: N/A
- Library resources: N/A
- Information Technology: N/A

Impact on Distribution Requirements and Other Courses: None

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Rolle, Chair)
Re: New Course Proposal
CE 575 Climate and the Earth System

Motion: The Committee on Graduate Studies and Research recommends, and I move, that CE 575, Climate and the Earth System, as described below and approved by CEE on 11 Sept 2020, be added to course offerings.

Course/Catalog Description: CE 575, Climate and the Earth System, Cat. I. (2 credits)
This course deals with the Earth's operation as a system, covering its energy budget along with its interacting atmosphere, ocean, biosphere and geologic systems. By showing how all systems work together to form feedback loops that can amplify or counteract input perturbations and forcings of the overall system, the course illustrates how these systems modulate and control our planet's climate system. Throughout, an Anthropocene point of view is taken to study not only "natural" systems but also the ways in which human societies interact with and are an integral part of the Earth system. The course integrates physical, chemical, and biological basics to arrive at an understanding of complex natural and human systems.

Recommended Background: Two introductory science courses (physics, chemistry, biology, or geology).

Anticipated Instructor: Carrick Eggleston, Civil and Environmental Engineering

Rationale:
WPI has no Earth Science department or majors. Nevertheless, climate change is at the forefront of the global problems that all of our students face for the entirety of their careers and beyond, and its impacts will become more and more apparent with each passing year. WPI students need a basic grounding in how our planet works as a system of interacting atmospheric, ocean, biological and geological components to form feedback loops and systems that modulate and control the climate conditions in which we live now and in the future. This course will be part of the new Community Climate Adaptation MS program that CEE is participating in with DIGS in the Global School.

Implementation Date: 2021 A

Resource Needs:
- This will be part of Carrick Eggleston's normal teaching load.
- Classroom space for all of the students, which may grow over time – in the near term, this would possibly be an online course in fall 2021 if COVID remains a problem
- Laboratory: N/A
- Library: Journal Access to original articles
- IT: N/A

Impact on Distribution Requirements or other courses: None

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Rolle, Chair)
Re: New Course Proposal
IGS 545: Climate Change: Vulnerability and Mitigation (Cat. II) 3 credits, Spring

Motion: The Committee on Graduate Studies and Research recommend, and I move, that IGS 545 as described below, be added.

Course/Catalog Description:
IGS 545 (Cat. II) Climate Change: Vulnerability and Mitigation. Spring.
Taking climate change as a starting point, this course introduces students to a wide range of climate change conditions, human responses to those conditions, and points toward the need for deeper understanding of human-environment relationships. The course will draw from Geography, Economics, Global Environmental Change, and other cross cutting disciplines for theory and case studies. Examples of climate change risks and mitigation efforts will come from the developed and developing world and will include both urban and rural examples. Assessment techniques include small group projects, case-based testing, and in class and online discussions.

Recommended background: IGS 510 and CE 575 or permission of instructor.

Anticipated instructors: Seth Tuler or other DIGS faculty

Rationale: Global environmental change, especially climate change, is already proving to be a grand challenge to societies, ecosystems, and economies. While climate change impacts vary globally, people and governments are striving to reduce exposure to environmental risks and trying to design socio-ecological responses to improve welfare. The course addresses these key challenges, and will reinforce monitoring, evaluation, and learning techniques with students and faculty as they design desired course outcomes and procedures. This is an elective course in the proposed graduate program in Community Climate Adaptation. It is designed to provide further depth in geographic and economic aspects of climate change vulnerability, building on the content from the core courses in climate science and human dimensions of climate change. The course will add to WPI's offerings on climate change to support both the Community Climate Adaptation Master's program, as well as the previously approved IDEaS Master's degree program.

Implementation Date: It is expected that this course will be first offered in Spring 2022.

Resource Needs:
- This is a new graduate course and will be part of the normal load.
- Classroom/Zoom space for 12-15 people
- Laboratory: N/A
- Library resources: N/A
- Information Technology: N/A

Impact on Distribution Requirements and Other Courses: No

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Rolle, Chair)
Re: Motion to approve a new Master of Science in Cyber Security graduate program

Motion: The Committee on Graduate Studies and Research recommends and I move that the following new graduate program, Master of Science in Cyber Security, be added, as described below.

Summary:

The National Institute of Standards and Technology indicates there is a global shortage of 3 million cyber security professionals. These positions play an important role in finance, insurance, manufacturing, public policy, and defense. Without expertise in these areas, organizations suffer security breaches, which cost the global economy hundreds of billions of dollars annually. The demand for students with expertise in cyber security is strong and growing dramatically.

We propose to launch a **Master of Science in Cyber Security (MS-SEC)**, with both on-campus and online delivery. The MS-SEC will be master's degree that allows students to choose a path of study that focuses on applying security techniques, researches new techniques, or combines research with application. This program will build upon WPI's existing expertise in cyber security across the Computer Science, Electrical and Computer Engineering, and Mathematical Sciences departments and the Foisie School of Business. Within our existing courses, we are able to offer most of the courses that would be required for the Master of Science degree. But unlike our existing Specialization in Computer Security within the MS in Computer Science degree, the Master of Science in Cyber Security program is designed to appeal to students from a variety of majors with varying degrees of technical preparation. The program includes one new course and a new capstone project course.

Unlike peer and peer-aspirant institutions, WPI provides its Master of Science in Cyber Security degree through a blend of technical classes with applications, including human behavior dimensions and business. This allows students to put tools and technologies into a societal context. This unique approach allows us to differentiate ourselves from competing programs. Other programs seem to either be primarily technically-focused or business-centric. By having more flexible background requirements and having courses tailored towards supporting students with varying degrees of prior technical preparation, we have a unique market niche.

Cyber security is a strategic focus research area for WPI and we have attracted over $9 million from the National Science Foundation for scholarship programs to expand the federal cyber security workforce. Combined with the increasing demand, a program to allow students to enter this area would be timely for WPI.

Proposed Modifications to Graduate Catalog:

Program Goals and Objectives
With the growing demand for expertise in Cyber Security, the Master of Science in Cyber Security (MS-SEC) provides a foundation in computing and security. The program balances technical expertise with its application in industry and government spaces. The program uses real-world experiential learning and research opportunities to ensure students are prepared for an evolving threat landscape.

Admissions Requirements
Applicants are expected to demonstrate sufficient background in computing for graduate-level work. Background in developing or using software tools is required. A bachelor's degree in Computer Science, Electrical Engineering, Information Technology, or other related fields should be adequate preparation. Students from other backgrounds are welcome to apply if they can demonstrate their readiness through other means, such as GRE exams, professional certifications, or relevant technical work experience.

Applicants must have earned the equivalent of a four-year U.S. bachelor's degree to be considered for admission. Admission decisions are based upon all the information required from the applicant. The GRE is not required for admission.

Non-matriculated students may enroll in up to two courses prior to applying for admission to the Master of Science in Cyber Security.

Faculty Contacts: Andrew Clark, Lorenzo De Carli, Yarkin Doroz, Daniel Dougherty, Fatemeh Ganji, William Martin, Koksal Mus, Patrick Schaumont, Craig Shue, Berk Sunar, Robert Walls, and Craig Wills.

Requirements for the Master of Science in Cyber Security (MS-SEC)
The Master of Science in Cyber Security allows students to pursue research or focus on applied courses that address security problems. Students may choose to complete either a capstone project or a MS thesis. The degree requires at least 30 credits hours of study, i.e., a minimum of ten 3-credit courses.

The MS-SEC is designed to accommodate students with significant prior preparation as well as those seeking to become professionals in the field. It supports both a standard and an advanced track of study. These tracks are for advising purposes only; students on either track earn the same credential and the selected track is not officially recorded. Under each track, students are encouraged to focus on either a software-centric or hardware-centric collection of courses.

MS-SEC students may take up to three bridge courses from:
- CS 5007 Introduction to Programming Concepts, Data Structures, and Algorithms
- CS 5008 Introduction to Systems and Network Programming [**new**]
- CS 509 Design of Software Systems

MS-SEC students must complete a three-course core focused on technical, human behavior, and business:
- One technically-focused course from:

    - CS 557 Software Security Design and Analysis
    - CS 558 Computer Network Security
    - DS/ECE 577 Machine Learning in Cybersecurity
    - ECE 579S Computer Security
    - ECE 579C Applied Cryptography and Physical Attacks
- One human behavior-focused course from:
    - CS 571 Case Studies in Computer Security
    - CS 525 Digital Forensics
    - CS 525 Computer Crime Law
    - ECE 579B Blockchain and Cryptocurrencies

- MIS 582 Information Security Management

MS-SEC students must complete three depth courses from the following:

- ECE 573/CS 578 Cryptography & Data Security
- ECE 673 Advanced Cryptography
- CS 564 Advanced Topics in Computer Security
- OIE 542 Risk Management & Decision Making
- Any core course from above that has not been used to satisfy the core requirement.

In the standard track, our bridge component supports students with less preparation to help them learn core concepts needed in subsequent classes. While highly recommended for those without previous technical preparation related to the field, these courses are optional preparation. Students who already have significant preparation in these areas, through undergraduate classes, graduate classes, or professional experience may choose not to take one or more bridge course without requiring advisor or program approval. For students on the software-centric standard track, CS 5007, CS 5008, and CS 509 are useful preparation.

In the advanced track, students may choose not to take any of the bridge courses and instead focus on technical depth or electives. Students on the advanced software-centric track may prefer to take either CS 557 or CS 558. Students on the advanced hardware-centric track may prefer to take DS/ECE 577 Machine Learning in Cybersecurity or ECE 579C Applied Cryptography and Physical Attacks.

MS-SEC students who do not take all of the bridge courses may select to take thesis credits or additional elective courses from the following to reach the 30-credit requirement:

- CS 502 Operating Systems
- CS 513 Computer Networks
- CS 534 Artificial Intelligence
- CS 539 Machine Learning
- CS 542 Database Management Systems
- CS 546 Human-Computer Interaction
- CS 548 Knowledge Discovery and Data Mining
- CS 573 Data Visualization
- ECE 506 Introduction to Local and Wide Area Networks
- ECE 5307 Wireless Access and Localization

- Undergraduate courses through the BS/MS program that have significant material overlap with the above graduate courses, as specified in the following section.
- Any core or depth course from above that has not been used to satisfy either the core or depth requirements.

MS-SEC students must complete a three-credit capstone project experience or a nine-credit MS Thesis from the following:

- CS 587/ECE 588 Cyber Security Capstone Experience
- CS 599/ECE 599 Master's Thesis

In the core requirements, students are exposed to a technically-oriented course, a human behavioral dimension course, and a course that relates security to business needs. This combination allows students to put technical material into a societal context.

With these requirements, students on the standard track may complete 3 bridge courses, 3 core courses, 3 depth courses, and the capstone experience for a total of 30 credits. Students on the advanced track may omit the bridge courses and instead take 3 core courses, 3 depth courses, 3 elective courses, and the capstone experience totaling 30 credits. For students pursuing a thesis, the capstone and two elective courses may be swapped for a 9-credit MS thesis.

For the Joint Bachelor's/Master's Program

The requirements for the MS-SEC are structured so that undergraduate students would be able to pursue a Bachelor's/Master's program, in which the Bachelor's degree is awarded in any major offered at WPI and the Master's degree is awarded as the MS-SEC. Students enrolled in the joint Bachelor's/Master's program must satisfy all the program requirements of their respective bachelor's degree and all the program requirements of the MS-SEC. WPI allows the double counting of up to 12 credits for students pursuing a 5-year Bachelor's/Master's program. This overlap can be achieved through the following mechanisms. Students may double-count courses towards both their undergraduate and graduate degrees whose credit hours total no more than 40 percent of the 30 credit hours required for the MS-SEC, and that meet all other requirements for each degree. These courses can include graduate courses as well as certain undergraduate 4000-level courses as long as the undergraduate courses are acceptable in place of a corresponding graduate course that satisfies a MS-SEC requirement.

In consultation with the academic advisor, the student prepares a Plan of Study outlining the selections chosen to satisfy the Bachelor's/Master's program degree requirements, including the courses that will be double-counted. This Plan of Study must then be approved by the Cyber Security program. As a university wide rule, the B.S./M.S. double counting credits can be applied for only while the student is an undergraduate student.

For the following 4000-level courses, two graduate credits will be earned towards the joint Bachelor's/Master's degree if the student achieves grade B or higher, or otherwise with the instructor's approval. In addition, faculty may offer, at their discretion, an additional 1/6 undergraduate unit, or equivalently a 1 graduate credit, for completing additional work in the course. To obtain this additional credit, the student must register for 1/6 undergraduate unit of independent study at the 4000-level or a 1 graduate credit independent study at the 500-level,

with permission from the instructor. A student can receive credit for at most one of the two courses in any row of the following table.

Undergraduate Course	**Graduate Course**
CS 4341 Introduction to Artificial Intelligence	CS 534 Artificial Intelligence
CS 4342 Machine Learning	CS 539 Machine Learning
CS 4401 Software Security Engineering	CS 557 Soft. Security Design & Analysis
CS 4432 Database Systems 2	CS 542 Database Management Systems
CS 4445 Data Mining and Knowledge Discovery in Databases	CS 548 Knowledge Discovery and Data Mining
CS 4513 Distributed Systems	CS 502 Operating Systems
CS 4516 Advanced Computer Networks	CS 513 Computer Networks

Students may additionally double-count CS 4404 (Tools and Techniques in Computer Network Security) or CS 4801/ECE 4802 (Introduction to Cryptography and Communication Security) towards the joint Bachelor's/Master's degree.

Other 4000-level courses not listed above, including 4000-level independent study courses, require a petition and approval from the Cyber Security Graduate Committee before they can double-count for the Bachelor's/Master's degree.

Satisfying MS-SEC Core Areas
Students with Bachelor's/Master's credit for CS 4401 (Software Security Engineering), CS 4404 (Tools and Techniques in Computer Network Security), or CS 4801/ECE 4802 (Introduction to Cryptography and Communication Security) may use that course to satisfy the technically-focused core course requirement. Alternatively, the student may instead apply that course credit towards either the depth or the elective requirements. For any other undergraduate course or independent study/project work, students may submit a petition along with a detailed course description and syllabus to the Cyber Security Program for final decision on whether the course should count towards core area requirements.

New Course Descriptions:
The following new courses are proposed for this new degree program:

- CS 5008 Introduction to Systems and Network Programming
- CS 587/ECE 588 Cyber Security Capstone Experience

The motions to add these courses and the rationale for doing so are included in a separate set of motions.

Comparison to Existing Programs at WPI
The Master of Science in Computer Science (MS-CS) degree has a specialization option in Computer Security and is the closest existing program offering. The MS-CS degree requires an undergraduate preparation in Computer Science. It requires technical expertise in algorithms and computational theory. Such expertise is not required for many cyber security career options and greatly narrows the pool of applicants that could complete such a degree. Further, Computer Science often involves the creation of new abstractions, software, and research. In contrast, the

MS-SEC is designed to support students from broader backgrounds. The MS-SEC provides the necessary foundation in programming, systems, and networks for students to build upon when understanding how security works.
The Master of Science in Information Technology (MS-IT) degree is focused on integrating technology into business. It provides students with an understanding of computing applications and relates them to organizational needs. The Cybersecurity Management Graduate Certificate requires two courses, "Risk Management and Decision Analysis" and "Information Security Management," which focus on organizations and security. The certificate also requires two additional courses from the broader School of Business. In contrast, the MS-SEC focuses more on the technical underpinnings of computing systems, with a substantial amount of Computer Science courses.
The Master of Science in Electrical and Computer Engineering (MS-ECE) includes courses in cryptography, blockchain security, machine learning security, and hardware security. The MS-ECE requires mathematical expertise that is not required in the MS-SEC.

Impact on Existing Programs at WPI

The proposed MS-SEC overlaps with existing programs in CS and ECE. Students may decide to switch from either MS program to the MS-SEC program or vice versa through the graduate admissions process. However, we expect students with a stronger technical preparation will prefer to apply to the CS or ECE MS degrees.

Students may participate in the MS-SEC through the BS/MS program. They may apply credit from certain undergraduate courses towards the MS-SEC as specified above.

Comparison with Other Programs

We evaluated the program nationally and with a focus on schools in the northeastern region of the United States. Cyber security program offerings vary in degree title and background requirement. However, they tend to be either 1) more technically focused with significant background requirements, similar to our own current Computer Security specialization within the Computer Science Master of Science degree or 2) focus on business goals and risk management, such as Information Security or Cyber Security Management degrees. Our approach of providing a bridge into a technical program that also allows student to explore applied security and business needs appears to be a differentiator.

We provide more information at https://grads.cs.wpi.edu/sec_masters_supplemental_table.pdf. This provides the data tables of the peers we analyzed, both nationally and regionally.

Implementation:

Program Management

The program will be led by the existing Cyber Security Program Director, Craig Wills. Craig Shue, the director of the WPI Scholarship for Service program in cyber security, and Berk Sunar, the director of the Vernam cyber security lab, will manage admissions to the program. Where needed, we will create a graduate committee from the 12 faculty currently associated with cyber security. As the program grows, additional resources for program management may be required.

Implementation Date

On-campus: Implementation date for this new program is the 2021-2022 academic year.
Online: Online implementation (if we implement online) will happen over two years, with slightly more than half the courses implemented during the first year and the remaining during the second year. Targeted start for implementation is the 2021-2022 academic year.

Resources Required:

On-campus: We will need coverage for two new courses, each offered once per year. We will further require an offering of the capstone experience annually. We are requesting one teaching track (TRT) faculty for the 2021-2022 academic year for the on-campus program.
Online: If we deliver this program online, we will need additional faculty because current faculty are fully loaded. These courses may be offered with TRT or adjunct faculty.

Rationale:

The MS-SEC program provides an opportunity in a high-demand area. By designing the program towards broad audiences, it offers an opportunity for professionals to extend their existing undergraduate degrees into the security domain. This helps address market demand. Further, it supports our existing cyber security scholarship programs, by providing students with more educational routes that are compatible with the scholarships, attracting more top quality applicants, and allowing WPI to show continued investment in cyber security, which is needed for these grants.

This motion was endorsed by the Foisie Business School faculty on September 9, 2020. It was approved by the Computer Science department faculty on November 17, 2020. It was approved by the Electrical and Computer Engineering department faculty on November **XX**, 2020.

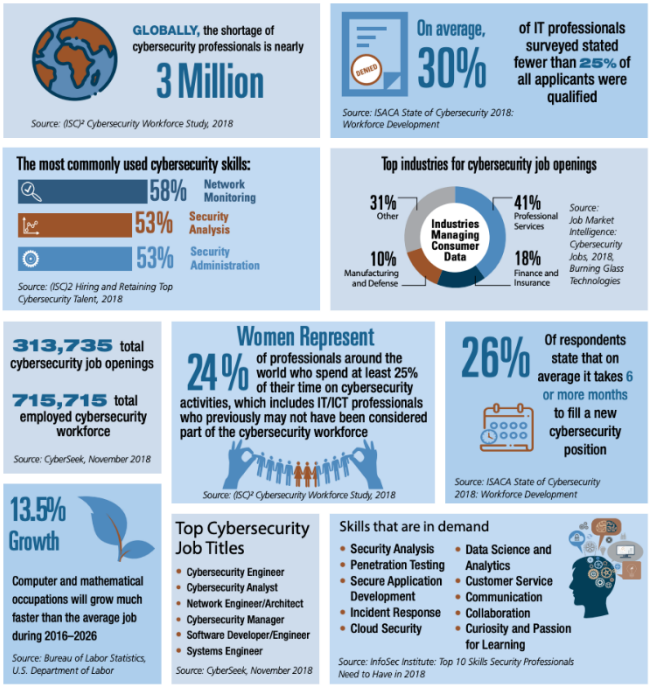
Opportunity and Market Analysis

In the included infographic, the National Institute of Standards and Technology indicates over 313 thousand cybersecurity job openings in the US and a global talent shortfall of 3 million professionals [1]. They highlight findings from multiple sources, indicating the types of skills in demand, the lack of qualified applicants in the field, difficulty recruiting for open positions, diversity challenges, and projected growth.
According to the nonprofit Center for Strategic and International Studies [2], the global cybersecurity workforce is projected to reach 1.8 million unfilled positions by 2022. They report that 61% of organizations find fewer than half of their applicants for open cybersecurity positions were qualified for the job. A NIST-sponsored project, Cyber Seek [3], reports that there

is “a dangerous shortage of cybersecurity workers in the United States that puts our digital privacy and infrastructure at risk.”

As an example, we consider the Information Security Analyst position. Cyber Seek reports an annual talent shortfall of 46,000 workers for this analyst position alone. The US Bureau of Labor Statistics [4] projects a 32% increase in Information Security Analyst positions through 2028. They further found the position has a median pay of $99,730 in 2019 and a “much faster than average” job growth outlook [5].

The demand for cyber security professionals has translated into increased demand for academic degrees. According to IPEDS data [6, 7], the “computer and information sciences” field, which includes cyber security, is growing substantially with BS degrees growing from 39,593 in AY 2009-2010 to 79,598 in AY 2017-2018. In the same 8-year time period, MS degrees grew from 17,955 to 46,468. According to Google AdWord data, the average monthly search volume for master’s degrees in cybersecurity was 4,170, which indicates strong continued interest in degrees in this space.



NIST infographic providing cyber security market demand [1]

The talent shortfall, high pay, and employer desire for more qualified applicants drive the demand for more cyber security educational opportunities.

[1] National Institute of Standards and Technology, “Cybersecurity Workforce Demand,” February 7, 2019. [online] https://www.nist.gov/system/files/documents/2019/02/07/workforce_demand_111617_final.pdf

[2] Center for Strategic and International Studies, “The Cybersecurity Workforce Gap,” January 29, 2019. [online] https://www.csis.org/analysis/cybersecurity-workforce-gap

[3] Cyber Seek, “Hack the Gap: Close the cybersecurity talent gap with interactive tools and data,” 2020. [online] https://www.cyberseek.org/

[4] U.S. Bureau of Labor Statistics, “Employment Projections,” September 4, 2019. [online] https://www.bls.gov/emp/tables/emp-by-detailed-occupation.htm

[5] U.S. Bureau of Labor Statistics, “Occupational Outlook Handbook: Information Security Analysts,” April 10, 2020. [online] https://www.bls.gov/ooh/computer-and-information-technology/information-security-analysts.htm

[6] U.S. Department of Education, National Center for Education Statistics, Higher Education General Information Survey (HEGIS), "Degrees and Other Formal Awards Conferred" surveys, 1970-71 through 1985-86; Integrated Postsecondary Education Data System (IPEDS), "Completions Survey" (IPEDS-C:91-99); and IPEDS Fall 2000 through Fall 2018, Completions component. [online] https://nces.ed.gov/programs/digest/d19/tables/dt19_322.10.asp

[7] U.S. Department of Education, National Center for Education Statistics, Higher Education General Information Survey (HEGIS), "Degrees and Other Formal Awards Conferred" surveys, 1970-71 through 1985-86; Integrated Postsecondary Education Data System (IPEDS), "Completions Survey" (IPEDS-C:91-99); and IPEDS Fall 2000 through Fall 2018, Completions component. [online] https://nces.ed.gov/programs/digest/d19/tables/dt19_323.10.asp

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Rolle, Chair)
Re: Motion to approve a new Master of Computer Science (MCS) graduate program

Motion: The Committee on Graduate Studies and Research recommends, and I move, that the following new graduate program, Master of Computer Science (MCS), be added, as described below.

Summary:
A recent report from the National Academies of Sciences, Engineering and Medicine (NASEM, 2018) finds that bachelor's degree production in computer and information science majors (at not-for-profit institutions) increased 74% between 2009 and 2015 (a total of 60,266). However, the growing demand in the United States for computing professionals cannot be satisfied only by the traditional model of undergraduate and graduate degrees in computer science. The goal is to design degrees that are more accessible and train students in high-demand skills for computing jobs.

Proposed Modifications to Graduate Catalog:

Program Goals and Objectives
With the growing demand for high-demand computing skills, the Master of Computer Science (MCS) provides an applied foundation in computer science. The program balances technical expertise with its application in industry. The program uses real-world experiential learning to ensure students are prepared for an evolving job market.

Admissions Requirements
Applicants are expected to demonstrate sufficient background in computing for graduate-level work. A bachelor's degree in Computer Science, Electrical Engineering, Information Technology, or other related fields should be adequate preparation. Students from other backgrounds are welcome to apply if they can demonstrate their readiness through other means, such as GRE exams, professional certifications, or relevant technical work experience.

Applicants must have the earned equivalent of a four-year U.S. bachelor's degree to be considered for admission. Admission decisions are based upon all the information required from the applicant. The GRE is not required for admission. A Statement of Purpose is not required for admission.

Non-matriculated students may enroll in up to two courses prior to applying for admission to the Master of Computer Science program.

Faculty Contacts: George Heineman and Craig Wills.

Requirements for the Master of Computer Science (MCS)
The Master of Computer Science is an applied, terminal degree that does not provide options related to a research degree and does not include a thesis option or research seminars. The MCS degree requires at least 30 credits hours of study, i.e., ten 3-credit courses.

The MCS degree is designed to accommodate students with significant prior preparation as well as students seeking to become professionals in the field. A three-course foundation ensures incoming students have sufficient preparation for the more advanced Computer Science courses. A required design core solidifies skills in core areas of Computer Science. Students can take three elective courses, guided by several focus areas we have identified. Observe that the foundation and core classes can be specialized with electives to focus on different interests while also providing sufficient training for skilled positions in industry.

Foundation (6 credits)
MCS students may take up to two courses of foundation as follows, based on their individual preparation. Our foundation component acts as a bridge for students with less preparation to learn core concepts needed in subsequent classes. Students with significant preparation in these areas – through undergraduate classes, graduate classes, or professional experience – can take additional electives instead.

- CS 5007 Introduction to Programming Concepts, Data Structures, and Algorithms
- CS 5008 Introduction to Systems and Network Programming [**new**]

Design Core (12 credits)
MCS students are required to complete four courses focused on design to demonstrate mastery of a broad range of design issues in Computer Science and gain essential software developer skills.

- CS 5084 Introduction to Algorithms: Design and Analysis
- CS 509 Design of Software Systems
- CS 542 Database Management Systems
- *Either*
  - CS 528 Mobile and Ubiquitous Computing **or**
  - CS 546 Human-Computer Interaction

Elective Courses (9 credits)
MCS students take nine additional graduate credits to complete, at most six of which can be from outside the CS department. Students may not count research-specific courses, such as CS 598, CS 599, or CS 699, towards the MCS nor may they pursue a thesis (which is available in the Master's of Science in Computer Science program). Further, students may not count CS 587, the capstone for the MS in Cyber Security, towards the MCS. Any other graduate-level CS classes not used to meet other MCS requirements may count towards the MCS electives. The following focus areas are suggestions, but students may use other graduate courses as previously described to meet the requirements.

Artificial Intelligence/Machine Learning Focus

- CS 534 Artificial Intelligence
- CS 541 Deep Learning
- CS 548 Knowledge Discovery and Data Mining

Cybersecurity Focus

- CS 554 Introduction to Computer Security Tools and Techniques
- CS 557 Software Security Design and Analysis
- CS 558 Computer Network Security

Big Data Management Focus

- CS 573 Data Visualization
- CS 585 Big Data Management
- CS 586 Big Data Analytics

Computing Systems Focus

- CS 502 Operating Systems
- CS 513 Computer Networks
- CS 525 ST: Cloud Computing
- CS 535 Advanced Topics in Operating Systems
- CS 577 Advanced Computer and Communications Networks

Capstone Experience (3 credits)
MCS students must complete a capstone project experience as follows:

- CS 588 Computer Science Capstone Experience

With these requirements, students with no prior background may complete 2 foundation course, 4 design core courses, 3 elective courses, and the Capstone Experience for a total of 30 credits. Students with strong prior backgrounds may omit some foundation courses and instead complete additional elective courses.

New Course Descriptions:
The following new courses are proposed for this new degree program:

- **CS 5008 Introduction to Systems and Network** (new course)
- **CS 588 Computer Science Capstone Experience** (new course)

The motions to add these courses and the rationale for doing so are included in a separate set of motions.

Rationale:

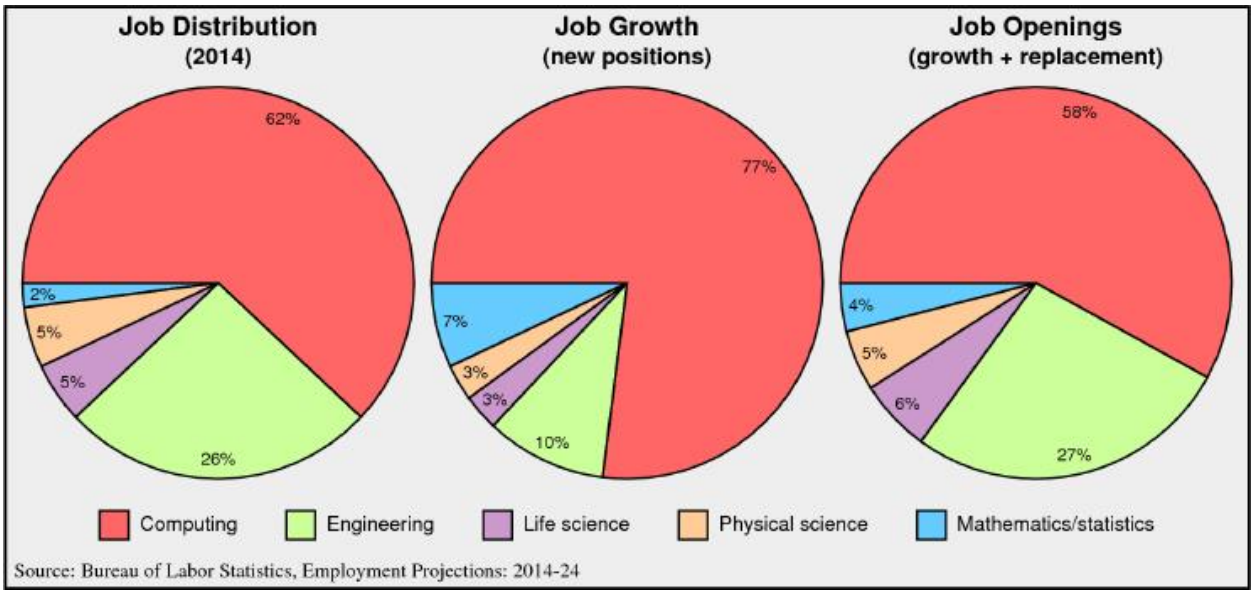
The Master of Computer Science degree program provides an opportunity in a high-demand area. By designing the program towards broad audiences, it offers an opportunity for professionals to extend their existing undergraduate degrees into careers involving significant computing.

This terminal degree does not have the same focus as the MS in Computer Science and should appeal to a broader range of potential students who are interested in becoming professionals in the field. Students interested in pursuing research in Computer Science should apply to the Master of Science (MS) in Computer Science degree program.

The two-course **foundation** is designed in conjunction with the Master of Science in Cyber Security degree program. CS 5008 is a new course that provides sufficient exposure to concepts from operating systems and computer networks. The **core** set of courses ensures students will learn essential developer skills in User Interface design (CS 546), Database design (CS 542) and Mobile applications (CS 528). The **capstone experience** will ensure students demonstrate competence in completing a non-trivial computer science project, from inception to completion.

Opportunity and Market Analysis

Every two years the United States Bureau of Labor Statistics publishes projections of employment trends for the next decade. In the most recent projections, covering the decade from 2014 to 2024, the BLS predicted that the number of people employed in computing occupations will rise from 3,916,100 to 4,404,700 [1]. They estimate that computing occupations are growing nearly twice as fast as the labor market as a whole.



Projected employment growth for occupations in STEM and STEM-related fields (social sciences not included), 2014-2024.

The talent shortfall, high pay, and employer desire for more qualified applicants drive the demand for more computing professionals.

Comparison to Existing Programs at WPI

The Master of Science in Computer Science (MS CS) degree requires an undergraduate preparation in Computer Science. It requires technical expertise in algorithms and computational

theory. Such expertise is not required for many computing career options and greatly narrows the pool of applicants that could complete such a degree. Further, the MS CS prepares students to become involved in the creation of new abstractions, software, and research. In contrast, the MCS is designed to support students from broader backgrounds. The MCS provides the necessary foundation in programming, systems, and networks for students to contribute to the computing field.

The Master of Science in Information Technology (MSIT) degree is focused on integrating technology into business. It provides students with an understanding of computing applications and relates them to organizational needs. In contrast, the MCS focuses more on the technical underpinnings of computing systems, with a substantial amount of Computer Science courses. Students interested in IT could specialize in this area with approval of the student's advisor.

The Master of Science and Master of Engineering in Electrical and Computer Engineering (MSECE) requires mathematical expertise that is not required in the MCS. These ECE degree offerings at WPI require seven courses in Electrical and Computer Engineering (ECE), with up to three courses from other departments, including Computer Science. MCS students interested in computer engineering could specialize in this area with approval of the student's advisor.

Comparison to Existing Programs at other Universities

A number of schools already have MCS degree programs; here are just a few

- University of Illinois Urbana-Champaign – The Master of Computer Science (MCS) from Illinois Computer Science is a professional degree program that "allows [students] to augment [their] education and accelerate [their]career by learning from world-class faculty who are advancing the frontiers of computer science" https://cs.illinois.edu/academics/graduate/professional-mcs

- Colorado State University – Offers "a practical orientation to computer science; cutting-edge research; a congenial, award-winning faculty; and an active student population." https://graduateschool.colostate.edu/programs/computer-science-mcs/

- Arizona State University – " The Online Master of Computer Science (MCS) program, offered through an innovative partnership between ASU's School of Computing, Informatics, and Decision Systems Engineering and Coursera, is a rigorous computing degree." https://asuonline.asu.edu/online-degree-programs/graduate/computer-science-mcs/

- Rice University – "Upon completing the MCS degree, students will be able to: (a) Solve advanced Computer Science problems. Students will acquire and apply a graduate-level understanding of material in sub-areas of Computer Science; (b) Design and implement complex software systems. Students will demonstrate skill in their design and implementation and function effectively in teams; (c) Communicate effectively to a client and user." https://ga.rice.edu/programs-study/departments-programs/engineering/computer-science/computer-science-mcs/

There is an opportunity for WPI to offer a graduate program that is within reach of computing professionals who do not have an undergraduate degree in Computer Science.

Impact on Existing Programs at WPI
The proposed MCS overlaps with an existing program in CS. Students may decide to switch from the MS in CS program to the MCS program or vice versa. However, we expect students with a stronger technical preparation will prefer to apply to the CS MS degree program.

The MCS degree is compatible with the goals of a combined BS/MS program, even for students whose undergraduate degree is not in Computer Science. The department currently offers a BS/MS for students who wish to pursue the MS degree in Computer Science; with the MCS degree program in place, we would offer a combined BS/MCS program which would be attractive to undergraduate majors who did not major in Computer Science.

Implementation:
Program Management
We would need, at the minimum, an admissions committee and a graduate committee that can revise this section of the catalog. Obvious folks from CS are: Heineman, Wills. As the program grows, new hires brought in to teach these courses will take on the responsibility of managing the program.

Implementation Date
On-campus: Implementation date for this new program is the 2021-2022 academic year.
Online: Online implementation (if we implement online) will happen over two years, with slightly more than half the courses implemented during the first year and the remaining during the second year. Targeted start for implementation is the 2021-2022 academic year.

Resources Required:
On-campus: We will need coverage for one new course offered once per year. We will further require an offering of the capstone experience annually. We are requesting one teaching track (TRT) faculty for the 2021-2022 academic year for the on-campus program.
Online: If we deliver this program online, we will need additional faculty because current faculty are fully loaded. These courses may be offered with TRT or adjunct faculty.

References
[1] BLS (Bureau of Labor Statistics). 2015. Employment Projections: 2014-2024: Table 11b. Online. Available at http://www.bls.gov/cps/cpsaat11b.htm

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Rolle, Chair)
Re: Motion to add CS 587/ECE 588: Cyber Security Capstone Experience

Motion: The Committee on Graduate Studies and Research recommends and I move that a new course, CS 587/ECE 588 "Cyber Security Capstone Experience," be added to the graduate catalog.

Course/Catalog Description:

CS 587/ECE 588. Cyber Security Capstone Experience (3 credits)
To reduce cyber security theory to practice, the capstone project has students apply security concepts to real-world problems. The capstone represents a substantial evaluation of the student's cyber security experience. Students are encouraged to select projects with practical experience relevant to their career goals and personal development. In the capstone, students will propose a project idea in writing with concrete milestones, receive feedback, and pursue the proposal objectives. Since cyber security is a collaborative discipline, students are encouraged to work in teams.
This course is a degree requirement for the Master of Science in Cyber Security (MS-SEC) and may not be taken before completion of 21 credits in the program. Given its particular role, this course may not be used to satisfy degree requirements for a B.S., M.S., or Ph.D. degree in Computer Science or Electrical and Computer Engineering or a minor in Computer Science or Electrical and Computer Engineering. Students outside the MS-SEC program must get the instructor's approval before taking this course for credit.

Rationale: This class is needed to support the Master of Science in Cyber Security. It serves as a practical experience to culminate the student's experience in the program. Students will pick a project in their particular area of interest. A single capstone course offering will coordinate the proposal process, project advising, and evaluation of deliverables across independent student-driven projects.

Implementation Date: The course would be added in the 2021-2022 academic year.

Resource Needs and Anticipated Instructor:

- **Instructor** – The course can be taught by any of the 15 current cyber security faculty. The course can be offered with current faculty resources. As demand for the program grows, additional resources may be required.
- **Classroom and Laboratory** – This course can be taught in any standard classroom. The course does not have a laboratory component and does not require specific facilities.
- **Library Resources** – The course does not have special library resource requirements.
- **Information Technology –** This course will not require special IT resources.

Impact on Distribution Requirements and Other Courses:

This course does not replace any existing courses and will have minimal impact on existing programs.
The proposed course numbers were provided to the CS and ECE departments by Kristin McAdams after being checked for previous use.

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Rolle, Chair)
Re: Motion to add CS 588: Computer Science Capstone Experience

Motion: The Committee on Graduate Studies and Research recommends and I move that a new course, CS 588 "Computer Science Capstone Experience," be added to the graduate catalog.

Course/Catalog Description:

CS 588. Computer Science Capstone Experience (3 credits)
The capstone represents a substantial evaluation of the student's computer science experience. Students are encouraged to select projects with practical experience relevant to their career goals and personal development. In the capstone, students will propose a project idea in writing with concrete milestones, receive feedback, and pursue the proposal objectives. Students are encouraged to work in teams. This course is a degree requirement for the Master of Computer Science (MCS) and may not be taken before completion of 21 credits in the program. Given its particular role, this course may not be used to satisfy degree requirements for a BS, MS, or PhD degree in Computer Science or a minor in Computer Science. It may not be taken by students in other degree programs.

Rationale: This class is needed to support the Master of Computer Science program. It serves as a practical experience to culminate the student's experience in the program. Students will pick a project in their particular area of interest. A single capstone course offering will coordinate the proposal process, project advising, and evaluation of deliverables across independent student-driven projects.

Implementation Date: The course would be added in the 2021-2022 academic year.

Resource Needs and Anticipated Instructor:

- **Instructor** – The course can be taught by any of the current Computer Science faculty or by new faculty requested to support the MCS program.
- **Classroom and Laboratory** – This course can be taught in any standard classroom. The course does not have a laboratory component and does not require specific facilities.
- **Library Resources** – The course does not have special library resource requirements.
- **Information Technology –** This course will not require special IT resources.

Impact on Distribution Requirements and Other Courses:
This course does not replace any existing courses and will have minimal impact on existing programs.
The proposed course number was provided to the CS department by Kristin McAdams after being checked for previous use.

Date: December 10, 2020
To: WPI Faculty
From: Committee on Graduate Studies and Research (Prof. Rolle, Chair)
Re: Motion to add CS 5008: Introduction to Systems and Network Programming

Motion: The Committee on Graduate Studies and Research recommends and I move that a new course, CS 5008 "Introduction to Systems and Network Programming," be added to the graduate catalog.

Course/Catalog Description:

CS 5008. Introduction to Systems and Network Programming (3 credits).
This course is focused on significant programming projects and provides an overview of the principles of computer networks and a general-purpose operating system. The course provides the student with an understanding of the basic components of an operating system, including processes, synchronization and memory management. The course exposes students to the Internet protocol suite networking layers while providing an introduction into topics such as wireless networking and Internet traffic considerations. The objective is to focus on an understanding of fundamental concepts of operating systems and computer network architecture from a design and performance perspective.
Students will be expected to design and implement a variety of programming projects to gain an appreciation of the design of operating systems and network technologies. This course may not be used to satisfy degree requirements for a B.S., M.S., or Ph.D. degree in Computer Science or a minor in Computer Science. It may satisfy the requirements for other degree programs at the discretion of the program review committee for the particular degree. (Prerequisites: Experience with at least one high-level programming language such as obtained in CS 5007.)

Rationale: This class is needed to support the Master of Computer Science and the Master of Science in Cyber Security. It is necessary as a foundations course for both programs for students with less preparation in Computer Science and Cyber Security.

Implementation Date: The course would be added in the 2021-2022 academic year.

Resource Needs and Anticipated Instructor:

- **Instructor** – The course can be taught by any of the existing Computer Science systems and networking faculty. The course can be offered with current faculty resources. As demand for the program grows, additional resources may be required.
- **Classroom and Laboratory** – This course can be taught in any standard classroom. The course does not have a laboratory component and does not require specific facilities.
- **Library Resources** – The course does not have special library resource requirements.
- **Information Technology –** This course may use the isolated computer network already present in Fuller Labs along with existing computation resources. No additional support or equipment is needed.

Impact on Distribution Requirements and Other Courses:
This course does not replace any existing courses and will have minimal impact on existing programs.

The proposed course numbers were provided to the CS department by Kristin McAdams after being checked for previous use.