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Cluster Calculus

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PSU Integrated Cluster (IC) Project Funding Process & Proposal Form

Project Proposal Submittal Process: All IC projects requesting funding will require the completion and submittal of three (3) forms:

☒ **Project Proposal Form – project scope & outcomes** (*included in this document*)

☒ **Project Guidelines Form – reflective document outlining desirable IC project attributes**

☒ **Project Budget Form – Excel spreadsheet to facilitate budget planning**

Instructions for Submitting Project Proposals:

- ✓ Download the 3 forms to your computer
- ✓ Complete the forms and save them; including the title of your project in the file name
- ✓ Forward the 3 files via email to the IC Project Manager, Ross Humer rhumer@plymouth.edu
- ✓ Project Proposal will be logged & forwarded to the appropriate IC Guide Team

If not reviewed in advance of the submission, it is important to discuss the Project with the IC Guides to review, refine, and rework (if necessary) to obtain funding approval.

Project Funding Review Process: All proposed projects will be reviewed by the Cluster Guide team. Depending on the level of funding amounts being requested, the proposal request will follow the process outlined as follows:

- **Level 1:** Any project with a proposed budget of less than or equal to $1,000 can be approved by the Cluster without additional review
- **Level 2**: Any project with a proposed budget of $1,000 but less than $5,000 can be approved by the IC Project Review Team, which is made up of representatives from each of the 7 Clusters (*see release time exception directly below*)
- **Level 3**: Any project with a proposed budget of $5,000 or greater **or** requires faculty release time, must be first endorsed by the IC Project Review Team and submitted to the Academic Deans for review and approval

The project funding approvals are limited to one academic year; projects which require additional funding in subsequent years will need to be resubmitted annually for review and approval.

Deliverables: At the conclusion of the academic year, a deliverable to the Integrated Cluster Proposal Review Team and Academic Deans is required in order for the project director/coordinator, artist, or author and collaborator(s) to be eligible for future funding. This reporting requirement may be met by numerous means which will be identified as this process matures. It is anticipated that awardees will present their works before a wide public gathering to be scheduled during the upcoming Academic Year.

Instructions for the PSU Integrated Cluster Project Proposal Form: Please complete all of the elements of the following form in the spaces provided before saving and then submitting the document.

PSU Integrated Cluster Project Proposal Form

Title: Cluster Calculus

Project Leadership: (Identify Project Director/Manager or Co-Manager/s)

Emma Wright (Co-Director) & Justin Wright (Co-Director)

Project Description:

The goal of this project is to develop and initiate a permanent cluster activity around the university's calculus curriculum. The directors will develop active and inquiry based learning materials ("modules") to be used when teaching MA 2550, MA 2560, and MA 3540 (the calculus sequence). In each class, for each major that requires the class, the modules will deliver discipline specific content to the students. That is, students from Chemistry, Computer Science, Mathematics, and Meteorology will participate in activities designed specifically for their major, during which they will explore the applications of calculus concepts to their discipline. These modules will be designed in coordination with representative faculty members from the disciplines mentioned above to ensure that the students are being directly exposed to discipline specific terminology, methodology, and problems that can be explored or described using calculus. To be both impactful and efficient, the modules will be delivered in a self-guided and inquiry based format. Ideally, these modules will be delivered in addition to the traditional content of the calculus sequence. The most promising route for this addition is the creation of 1-credit co-requisite courses attached to the calculus sequence, though implementation schemes that do not increase credits will be considered.

Project Goals and Outcomes:

Project Goals – Briefly identify and describe the objectives of this project

-Identify and articulate clear learning outcomes needed to bridge the gap between the content of the calculus sequence and the content of students' majors.

-Develop materials that meet the mentioned learning outcomes and allow students to explore the applications of calculus to their majors.

-Find an appropriate credit implementation scheme that allows students to earn credit for their additional work without overwhelming the credits required for their majors or over-burdening the Mathematics Department.

-Develop a practical assessment scheme for the developed materials that allows for open-ended work and does not overwhelm instructors.

-Develop a practical scheme to allow programs of study to assess student learning of newly identified learning outcomes after completing the calculus sequence. Develop a reporting scheme for these assessments.

Student Learning Outcomes – Outline the expected student learning outcomes

A major goal of this proposal is to identify and clearly state appropriate student learning outcomes for the long-term cluster activity. Overall, the aim is to have students discover and explore how calculus describes their fields of study. Explicit learning outcomes will not be set until the development of learning modules has begun.

Rationale and Impact:

Considering the questions below, please write your project rationale and impact statement.

Include how this project will further the Mission and Vision of PSU with respect to 1) fostering collaboration across disciplines; 2) addressing a relevant societal issue, and 3) establishing relationships with community partners, external institutions, companies, non-profits, schools, government agencies, etc. and 4). Making an impact

How does this proposed project advance the Integrated Cluster mission and vision? How does this project facilitate high impact teaching and learning, cross disciplinary collaboration, student engagement and partnership involvement, and real world problem exploration? What are the anticipated impacts of this project?

Is this project an extension of work already in progress, or an entirely new endeavor? Does it integrate with areas that team leaders are already teaching or is it an opportunity to delve into unfamiliar content or a bit of both?

Project Rationale and Impact Statement:

The content of a traditional calculus sequence, like that currently at PSU, is broadly designed to encompass the disciplines of the students the courses serve. Some topics are taught that may only apply to one or two majors serviced by the course, while other topics are important to all students but their applications vary by discipline. Further, the curriculum is principally determined by the Mathematics Department despite the fact math majors tend to be the minority in the course. The new Cluster Calculus modules will allow the calculus curriculum to be simultaneously broadened and focused. Students will be directly taught the application of this oft-required course to their own disciplines while taking the calculus sequence, rather than their respective programs being forced to close the gap in other courses. Students will better understand the value of calculus and be better prepared to tackle its uses within their future courses and work. This effort will increase interaction between programs that require calculus and help students see the integrated nature of math and the sciences.

The Cluster Calculus project will enable students to begin addressing societal issues and problem solving in several ways. By clearly connecting calculus to their disciplines, students will spend additional

time delving into problems within their disciplines. This advanced preparation will allow students to go further in their subsequent coursework and cluster activity. Additionally, student participation in Cluster Calculus addresses a societal issue. Research shows that students are more engaged in math, and therefore more likely to succeed, if they understand the relevance of math to their interests. By developing Cluster Calculus, the directors hope to explore student engagement and passion in the math classroom, which could potentially benefit the greater mathematical community.

Another benefit of the Cluster Calculus modules is that they will allow for high impact teaching and learning. The varied demands and tight timeline of the calculus curriculum make contemplative pedagogies nearly impossible to implement. However, the Cluster Calculus modules will allow students to tackle open ended problems in an inquiry based format without having to remove traditional content from the courses.

If Integrated Clusters are to exist in more than name, it seems likely that a more streamlined and integrated curriculum will be developed for courses that serve broad audiences. If departments are actually eliminated, then oft-required courses like the calculus sequence will fall under the purview of the clusters. The Cluster Calculus project will eventually serve as a model for this style of curricular integration that will separate PSU from its competitors. The calculus sequence is an ideal sandbox for this process as it serves a broad but relatively small number of programs, runs frequently but not with many sections, and serves capable and mature students.

It is not uncommon for large universities to offer several different calculus sequences, with curricular redundancies, in order to serve the many dependent majors. A similar structure can be found in the range of statistics courses available at PSU. Further, examples can be found at other institutions of courses that exist entirely to bridge the gap between a traditional calculus sequence and the discipline specific content. Both of these models are potentially costly to their home universities. The Cluster Calculus program will eliminate the potential need for superfluous courses while better serving our students.

Project Team

PSU Project Participants (essential core team participants including faculty and staff)

Name	Position/ Title	Project Role	Discipline/ Specialty	Email
Emma Wright	**Assistant Prof. of Mathematics**	**Co-director**	**Mathematics Engaged Learning Course Material Development**	**emwright@plymouth.edu**
Justin Wright	**Assistant Prof. of Mathematics**	**Co-director**	**Mathematics Calculus Curriculum Engaged Learning**	**Jpwright1@plymouth.edu**

Non-PSU Project Participants (stakeholders; partners; academic institution; etc.)

Name	Organization	Project Role	Discipline/ Specialty	Email

Student Participant Profile (Identify the student population/s to be engaged in the project. Identify if this has been or is planned to be incorporated into curricula)

Class/ Student Organization/ Individuals	Role in Project	Academic Level (Undergraduate or Graduate)	Academic Discipline	Total Student Population

IRB (Institutional Review Board) Compliance

IRB Compliance: http://www.plymouth.edu/office/institutional-review-board/

☒ This project DOES NOT require IRB compliance
☐ This project DOES require IRB compliance (*complete below*)

IRB Approval Status:

IRB Approval Date:

Any funding approvals of IRB-required projects are contingent on obtaining IRB approval.

Project Management: Timeline and Milestones

Identify the timeline for the project including start, completion, and major project milestones. A closing report will be required as a part of the project funding process.

Project Start Date: Fall 2016

Project Complete Date: Spring 2018

Project Milestone	Milestone Description	Target Completion Date
Identify Department Liaisons	**Directors identify and contact liaisons from impact departments to begin discussions, acquire potential sources for content, and research credit implementation strategy.**	**Spring 2017**
Identify Content	**Directors meet with department liaisons to identify necessary content, identify specific learning outcomes, and discuss credit implementation schemes.**	**August 2017**
Course Release/Development	**Both directors have 3-credit course release. They will release courses that can be easily taught by adjunctions or other department members.** **Weeks 1-3: Emma works to develop materials for MA2560. Justin works to develop materials for MA3540.** **Weeks 4-5: Directors meet with department liaisons to discuss developed materials and**	**December 2017**

	adjust as needed. Continue credit implementation discussions. **Weeks 6-9: Directors collectively work to finalize materials for 2560 and 3540. Finalize plans for credit implementation.** **Weeks 10-11: Directors meet with department liaisons to get final approval of developed materials. Begin development of 2550 materials.** **Weeks 12-14: Finalize 2550 materials. Begin catalog change or new course proposals as necessary.**	
Approval	**Directors meet with department liaisons for final approval on all materials and credit implementation schemes. Mathematics Department vote to approve catalog changes at department retreat.**	**January 2018**
Curriculum Change	**Catalog changes or course proposals are submitted to Curriculum Committee.**	**February 2018**
Implementation	**Run first implementation of developed materials while collecting student feedback during AY2018.**	**Spring 2019**
Final Evaluation	**Directors meet with departments involved and course instructors to obtain evaluation and feedback on process. Necessary adjustments are made.**	**August 2019**

Please identify any pre-project education or training for students, faculty, and staff that would be helpful for your project team to have in advance to begin work on a strong footing (e.g., skill training, concepts), and identify any training and education that you are willing to help provide during the preparatory period for the project team before team work formally begins.

Student Education/ Training Requirements: