UMass | Dartmouth

ACADEMIC AFFAIRS

NEW COURSE PROPOSAL FORM

New Courses proposed for a fall semester registration must be submitted to the Provost's Office for approval by the end of February of the previous spring semester.

Request prepared by: Sigal Gottlieb Date: November 17, 2015

Recommended by: **If required*

Dept. Curriculum Comm_____Comments_____ Date_____

Dept. Chairperson _____Comments_____ Date_____

College Curriculum Comm*_____Comments_____ Date_____

College/School Dean _____Comments_____ Date_____

University Curriculum Comm*_____Comments_____ Date_____

Approved by:

Provost/Designee_____Comments_____ Date_____

Notifications: OIRA_____ Registrar's Office_____ Other office_____

Proposed Course Prefix/Course No.: **MTH440**

1. Course Title: **Mathematical and Computational Consulting**

2. Academic Career: **Undergraduate** Graduate Law
   Effective Date: Fall 2016 Spring 20

3. Course Description:
Note: Limited to 60 words. The first line is a noun-phrase, not a complete sentence. Subsequent description (if any) consists of grammatically complete sentences. See instructions on website.

An intensive introduction to real-world mathematics using an assortment of mathematical challenges presented by industrial problems. This course aims to prepare students to integrate and apply their mathematical knowledge to novel problems presented in industrial or research settings. Topics will be selected from the following: multidisciplinary projects solicited from various research groups at UMass Dartmouth, from local and national industries/universities/labs, and from crowdsourcing websites.

4. Activity type (check one): **Lecture** Recitation Studio Research
   Laboratory Seminar Practicum Thesis/Dissertation Clinical
   Internship Private Lesson Studio with Lecture Field Studies Workshop
   Other (*be specific*)

5. Required Pre-requisites: None, but students are expected to be Calculus-ready. Calculus is a desired co-requisite.

6. Cross-listing (if any): Prefix/Course No.: MTH540
   Undergraduate **Graduate** Law
   Please attach a memo of approval from cross-listed department.

7. Credit Type: Degree Administrative credit Non-credit

8. Specify number of Credits: Fixed **3** or Variable from to

9. Required course for: Major Minor Other Math-Computational Math Option or Elective Course for

10. Repeatable credit? for Degree for Term
    Maximum number of credits

11. Grading:
    Letter grade (A-F) Pass/Fail Credit/No Credit
    In Progress (Please explain why.)

12. Scheduling type(s) (may select more than one):
    course to be scheduled with days, time, and room
    course to be blended (33-50% online and not requiring a classroom on specified day(s)
    course to be fully online (100% online and not requiring a classroom)
    course to be "to be arranged" (TBA)

RATIONALE FOR NEW COURSE

1. Role of Course in Curriculum
   How does this course address the learning outcomes of the current curriculum?

This course will contribute to the success of our students by preparing them to think and communicate mathematically, and exposing them to important mathematical concepts and techniques that are critical to a deeper understanding of mathematics.

2. Teaching pattern
   Generally, what will be the anticipated student enrollment? 16
   Generally, the number of sections to be scheduled when the course is offered: 1
   Generally, when will it be offered?

Every semester	**Every Fall**	Every Spring
Odd or Even Fall	Odd or Even Spring	PCE only
Other (explain):_____		

   Describe any special instructional modality or method of the course design, like team teaching:

3. Faculty Resources
   Is a specific professor or a group of professors [to be taught by him/her/them] proposing this course?
   If so, please identify:

   Other faculty qualified to teach the course (or, write "majority"):
   How does the department plan to have the instructional resources available to offer this course?

This course is an alternative to MTH181/MTH182 for math majors. The consequent reduction in the number of sections offered of those classes will release faculty members to teach this course.

4. Other Resources *(subject to LSIRT review)*
   Identify library and information literacy resources needed. How will these needs be met?

None

Is there required equipment that is not now available? How will this need be met?

No

Special instructional facilities needed (e.g., mediated classroom, laboratory, computer room)?

No

How will this need be met?

5. COURSE SYLLABUS

A new course proposal must include a standard course syllabus that should state clearly learning objectives and expected outcomes and workload, which explicitly demonstrates that the course work meets the federally mandate course credit hour requirement:

Credit Hour Definition: A credit hour is an amount of work represented in intended learning outcomes and verified by evidence of student achievement that is an institutionally established equivalency that reasonably approximates not less than—
(1) One hour of classroom or direct faculty instruction and a minimum of two hours of out of class student work each week for approximately fifteen weeks [includes exam week] for one semester or trimester hour of credit, or ten to twelve weeks for one quarter hour of credit, or the equivalent amount of work over a different amount of time; or
(2) At least an equivalent amount of work as required in paragraph (1) of this definition for other academic activities as established by the institution including laboratory work, internships, practicum, studio work, and other academic work leading to the award of credit hours.

The credit hour policy applies to all courses at all levels (graduate, professional, and undergraduate) that award academic credit whether it be fully online, a hybrid of face-to-face contact with some content delivered by electronic means, or one delivered in lecture or seminar format. Courses that have less structured classroom schedules, such as research seminars, independent studies, internships, practicum, studio work, or any other academic work leading to the award of credit hours, at a minimum, workload expectations that meet the standards set forth above. Academic units are responsible for ensuring that credit hours are awarded only for work that meets the requirements outlined in this policy.

The Dean will review the course type (lecture, seminar, studio, etc.), components, and the information that is presented here for credit hour compliance and resource implications and as a condition of approval, may modify, qualify, or limit what is stated

Syllabus credit hour requirement verified _____ Date_____

Additional information or comments:

Master Syllabus for this course is attached.

Master Syllabus
Course MTH440: Mathematical and Computational Consulting (MC^2)
Cross-listed Graduate Course: MTH540
Cluster Requirement: 5B (Learning Through Engagement)

Course Overview: The course will focus on learning, analyzing, and attempting to solve challenging real world research problems. The problems are selected from multidisciplinary projects solicited from various research groups at UMass Dartmouth, from local and national industries/universities/ labs, and from crowdsourcing websites. Developing skills to utilize computer algebra systems and problem solving environment software to rapidly prototype, quantify, visualize, and help understand or gain insights into the problems are the main objectives of this course.

Learning Outcomes:

Course-Specific Learning Outcomes: Students will experience hands-on training to analyze, study, and solve challenging research problems, where solutions are not fully understood or not yet available. Faculty instructors/advisors will help students in developing skills to think out of the box, to search relevant literature, to articulate ideas and discoveries through presentations and technical writing, and to build strong working relationships with their peers with different level of expertise as teams. Learning to honestly disseminate results to promote reproducible research is an expected outcome of this course.

University Studies Learning Outcomes: Students will experience discovery-based learning though engagement in research activities for solving real world problems. They apply techniques and methods learned from previous math, science, and engineering courses and the relations between them to help understand these problems and to propose new approaches. Through multidisciplinary collaborations among peers from different majors, and intensive communication with the industry, lab, or university clients that presented the problems, students shall develop skills in translating and communicating ideas and gain a unique understanding of how to work with people from different backgrounds and levels of expertise.

Examples of Texts: Due to the multidisciplinary nature of this course, we will be using books and journals from different branches of science, mathematics, and engineering from the UMass Dartmouth Library. Examples of journals are:

1. SIAM Journal on Applied Mathematics.
2. Journal of Computational Physics.
3. SIAM Journal on Scientific Computing.
4. Journal of Scientific Computing.

Example Learning Activities and Assignment: Research problems shall be requested from various research groups at UMass Dartmouth and from local and national industries/universities/labs. The research groups serve as our clients. Interaction with the client is the cornerstone of this experience. Regular communication with the clients is needed to elucidate the understanding of the nuances of the problem, verify that the mathematical model or methods presented are appropriate, and decide on useful measures or metrics and modes of presentation of data.

If there are no clients for any particular semester, problems can be taken from popular crowdsourcing websites such as kaggle.com. In such a case, students will join (or if needed create) blogs and wikis that engage the audience of interest (such as other kaggle competitors and the relevant community of scientists that presented the challenge) instead of individual clients.

By following the idea from Uppsala University Mathematical and Computational Consulting and Stanford University Statistical, Mathematical, and Computational Consulting, research topics may include but not limited to:

- Data Science
- Machine Learning
- Model fitting
- Time series
- Classification and prediction
- Mathematical Modeling and Rapid Prototyping
- Network Analysis
- Matrix Problems
- PDEs and Physical simulation
- Discrete Mathematics
- Optimization
- High Performance Computing
- Linear Algebra
- Scientific Computing

The course will extensively use the UMass Dartmouth content management system (CMS). Our clients and participating faculty members/advisors can submit data and relevant literature, access student reports, progress, presentations, Q/A forums, codes through CMS. Our clients will be invited to present their problems and to meet with students in the first week of the course. New studies or approaches obtained during the course can lead to paper collaborations, thesis projects, and or future internship appointments with the clients. Clients should acknowledge receipts of university policies on discrimination and sexual harassment. For legal issues, the university (including us) is not responsible for the damages caused by our mathematical models or numerical results.

The class will be run as a 14-week project-based seminar. The instructor and students will give weekly presentations, followed by discussions. Students will produce biweekly progress reports (including questions and proposed directions) and meet with the client multiple times during the semester to present their findings and discuss relevant directions and refinements of the original problem. The class is structured to simulate working in a company with a strict attendance policy and strict deadlines for submitting progress reports, and for presenting their findings to the client both during the process and at the conclusion of the project..

Note of the differences between the undergraduate and graduate versions: The depth and breadth of the required assignments will be different for the MTH440 than for MTH540. For example, the Literature search and summary will be, on average, 2-3 pages for MTH440 and 4-5 pages for MTH540. The Research proposal will be 3-5 pages for MTH440 and 6-8 pages for MTH540. The Final research paper will be 7-10 pages for MTH440 and 12-15 pages for MTH540.

Outcome Map

Univ St Learning Outcome	Teaching and Learning Activities	Student Work Products
1. Identify the needs and resources of the communities to which they belong.	Research problems shall be requested from various research groups at UMass Dartmouth and from local and national industries/ universities/labs. The research groups serve as our clients. If there are no clients for any particular semester, problems can be taken from popular crowdsourcing websites such as kaggle.com.	Students will prepare a l**iterature search and summary** that describes the problem of interest and defines the parameters of the project. In particular, students will identify the its relevance to the research group of interest and identify the role of computational mathematics in the broader scientific community using the particular scientific or engineering problem as an example.
2. Apply knowledge and skills gained through academic study to real problems and/or opportunities within their communities.	Students will apply techniques and methods learned from previous math, science, and engineering courses and the relations between them to help understand these problems and to propose new approaches.	Students will produce a **research proposal** in which they provide a mathematical model (typically in the form of equations) for the scientific problem at hand, and propose mathematical and computational approaches for solving the problem. This will be prepared in close collaboration with the client.
3. Describe the connections between learning on campus and the issues and needs of broader academic, professional or civic communities.	The clients presenting the research problem will be invited to present their problems and to meet with students in the first week of the course. The communication with these will be ongoing during the course of the semester.	Students will produce an **abstract** and a **poster** which describe the relevance of the mathematical model and the computational approaches to the solution of real-world problems in the engineering and scientific communities.

4. Articulate the value of engagement to other members of their communities.	The projects and results of the work will be described and widely disseminated to members of the mathematical, scientific, and engineering communities.	A **final research paper** will be posted online (where appropriate) or shared with the relevant research groups. This will provide a full description of the problem, including the motivation for the problem, the mathematical formulation, the mathematical and computational approaches used to solve the problem, and the implications of these results. The client's ongoing input will be highlighted in this paper, as part of the description of the process. This provides a clear justification that mathematics when applied to real-world problems through collaboration and communication can be of immense value. As part of the **poster** the students will be asked to address the value of this type of engagement in response to a specific prompt that requests them to reflect on specific benefits from their experience as well as suggest potential future benefits to the community.

Grading will be based on written and oral research reports including:

Literature search and summary	15%
Research proposal	25%
Abstract	15%
Poster	20%
Final research paper	25%