NJIT New Jersey's Science & Technology University

THE COLLEGE OF SCIENCE AND LIBERAL ARTS

THE DEPARTMENT OF MATHEMATICAL SCIENCES

MATH 677-002: Calculus of Variations
Spring 2020 Graduate Course Syllabus

NJIT Academic Integrity Code: All Students should be aware that the Department of Mathematical Sciences takes the University Code on Academic Integrity at NJIT very seriously and enforces it strictly. This means that there must not be any forms of plagiarism, i.e., copying of homework, class projects, or lab assignments, or any form of cheating in quizzes and exams. Under the University Code on Academic Integrity, students are obligated to report any such activities to the Instructor.

COURSE INFORMATION

Course Description: This course is intended to provide a broad overview of the field of calculus of variations for an application-minded student. The mathematical topics will include the direct method of calculus of variations, the Euler-Lagrange equation and regularity of solutions, convexity and uniqueness of critical points, Gamma-convergence and homogenization. The applications will include, time permitting, the Schrodinger eigenvalues, minimal surfaces, aggregation and electrostatics, phase transitions and microstructure, and optimal transportation.

Number of Credits: 3

Prerequisites: Math 645 or departmental approval.

Course-Section and Instructors

Course-Section	Instructor
Math 677-002	Professor C. Muratov

Office Hours for All Math Instructors: Spring 2020 Office Hours and Emails

No specific textbook will be followed, but some of the material will be drawn from:

- B. Dacorogna, "Introduction to the Calculus of Variations" (World Scientific, 2004)
- E. H. Lieb and M. Loss, "Analysis", 2nd edition (AMS, 2001)
- E. Giusti, "Minimal Surfaces and Functions of Bounded Variations" (Birkhauser, 1984)
- F. Santambrogio, "Optimal Transport for Applied Mathematicians" (Birkhauser, 2015)

For further, more advanced reading, see also:

- F. Rindler, "Calculus of Variations" (Springer, 2018)
- M. Struwe, "Variational Methods" (Springer, 2008)
- F. Maggi, "Sets of Finite Perimeter and Geometric Variational Problems" (Cambridge University Press, 2012)
- G. Dal Maso, "An introduction to Gamma-convergence" (Birkhauser, 1993)

University-wide Withdrawal Date: The last day to withdraw with a **W** is **Monday, April 6, 2020**. It will be strictly enforced.

POLICIES

DMS Course Policies: All DMS students must familiarize themselves with, and adhere to, the Department of Mathematical Sciences Course Policies, in addition to official university-wide policies. DMS takes these policies very seriously and enforces them strictly.

Grading Policy: The final grade in this course will be determined as follows:

Homework	30%
Midterm Exam	30%
Final Exam	40%

Attendance Policy: Attendance at all classes will be recorded and is **mandatory**. Please make sure you read and fully understand the Math Department's Attendance Policy. This policy will be strictly enforced.

Homework Policy: Homework will be assigned during class times and collected every few weeks.

Exams: There will be one midterm exam held in class during the semester and one comprehensive final exam. Exams are held on the following days:

Midterm Exam	TBA
Final Exam Period	May 8 - 14, 2020

The final exam will test your knowledge of all the course material taught in the entire course. Make sure you read and fully understand the Math Department's Examination Policy. This policy will be strictly enforced.

Makeup Exam Policy: There will be **NO MAKE-UP QUIZZES OR EXAMS** during the semester. In the event an exam is not taken under rare circumstances where the student has a legitimate reason for missing the exam, the student should contact the Dean of Students office and present written verifiable proof of the reason for missing the exam, e.g., a doctor's note, police report, court notice, etc. clearly stating the date AND time of the mitigating problem. The student must also notify the Math Department Office/Instructor that the exam will be missed.

Cellular Phones: All cellular phones and other electronic devices must be switched off during all class times.

ADDITIONAL RESOURCES

Further Assistance: For further questions, students should contact their instructor. All instructors have regular office hours during the week. These office hours are listed on the Math Department's webpage for Instructor Office Hours and Emails.

All students must familiarize themselves with and adhere to the Department of Mathematical Sciences Course Policies, in addition to official university-wide policies. The Department of Mathematical Sciences takes these policies very seriously and enforces them strictly.

Accommodation of Disabilities: Disability Support Services (DSS) offers long term and temporary accommodations for undergraduate, graduate and visiting students at NJIT.

If you are in need of accommodations due to a disability please contact Chantonette Lyles, Associate Director of Disability Support Services at 973-596-5417 or via email at lyles@njit.edu. The office is located in Kupfrian Hall, Room 201. A Letter of Accommodation Eligibility from the Disability Support Services office authorizing your accommodations will be required.

For further information regarding self identification, the submission of medical documentation and additional support services provided please visit the Disability Support Services (DSS) website at:

- https://www.njit.edu/studentsuccess/accessibility/

Important Dates (See: Spring 2020 Academic Calendar, Registrar)

Date	Day	Event
January 21, 2020	T	First Day of Classes
January 31, 2020	F	Last Day to Add/Drop Classes
March 15 - 22, 2020	Su-Su	Spring Recess: No Classes/ University Open
April 6, 2020	M	Last Day to Withdraw
April 10, 2020	F	Good Friday - University Closed
May 5, 2020	T	Friday Classes Meet - Last Day of Classes
May 6 & 7, 2020	W & R	Reading Days
May 8 - 14, 2020	F - R	Final Exam Period

Course Outline

Weeks	Subject Topic and HW Assignment
Weeks 1-2	Historic overview, basic ideas and issues
Weeks 3-5	Explicit optimization: Riesz rearrangement and optimal Constant in Hardy-Littlewood-Sobolev inequality
Weeks 6-8	Direct method: Schrodinger eigenvalues and capacity
Weeks 9-10	Direct method: The isoperimetric problem
Weeks 11-12	Gamma-convergence and homogenization
Weeks 13-14	Optimal transportation

Updated by Professor C. Muratov - 1/20/2020
Department of Mathematical Sciences Course Syllabus, Spring 2020