

Syllabus for MATH 5403, Calculus of Variations, Sec. 001

Fall 2019

Lectures: TR 1:30-2:45 p.m. in 809 PHSC

Class web page: http://www2.math.ou.edu/~npetrov/math5403_s19.html

Instructor: Prof. Nikola Petrov, npetrov@ou.edu, 1101 PHSC

Office Hours: Tue 9:30–10:30, Wed 12:00–1:00 (subject to change), or by appointment, in 1101 PHSC

Description from the Course Catalog: Linear spaces, global and local theories of optimization, necessary conditions for relative extrema of integrals. (Irreg.)

Prerequisites: 4433 (Intro to Analysis I) or 3423 (Physical Math II) or 4163 (Intro to PDEs)

Course description: I plan to cover Euler-Lagrange equations, Legendre transform, Hamilton's equations, Lagrange multipliers, Hamilton-Jacobi theory, conservation laws and Noether's theorem, second variation, conditions for strong and weak extrema. If time permits, we may discuss applications to eigenvalue problems and/or outline some ideas from optimal control theory (but certainly will not go into the latter in depth). I will probably sacrifice some mathematical rigor in favor of discussing more applications and examples. We will cover many interesting examples from Mechanics, Optics, and Geometry (isoperimetric problems, curves of shortest length).

Texts: The main textbook for the class is

[GF] I. M. Gelfand, S. V. Fomin, *Calculus of Variations*, Dover, 1991.

We may use parts of the following books, freely available from the OU Libraries web-site for OU students:

[vB] B. van Brunt, *The Calculus of Variations*, Springer, 2004,

[RB] A. Rojo, A. Bloch, *The Principle of Least Action*, Cambridge University Press, 2018,

[K] H. Kielhöfer, *Calculus of Variations: An Introduction to the One-Dimensional Theory with Examples and Exercises*, Springer, 2018.

Grading: Your grade will be based on the following:

Homework (lowest grade dropped)	60 %
Take-home midterm exam	15 %
Take-home final exam	25 %

Attendance: You are expected to attend all lectures, and you are responsible for all information given out during them. You are expected to arrive on time for the lectures, properly prepared and in good physical condition – in particular, adequately rested and up to date on the course material – so that you can maintain full concentration for the entire lecture.

All electronic equipment should be turned off before the start of every lecture, and should remain off until the class is dismissed. Since learning calculus requires your full attention, activities such as *conversing with other students, eating, sleeping, reading a newspaper, listening to headsets, using computers, cell phones, or other electronic devices, are not allowed!*

Homework: The homework assignments will be given on the class web site. Your homework solutions must be turned in at the beginning of class on the due date. Giving just an answer to a problem is not worthy any credit – you have to write a complete solution which gives your step-by-step reasoning and is written in grammatically correct English. Your lowest homework grade will be dropped. You are encouraged to discuss the homework problems with other students, but you should write up the solutions in your own words.

Some important dates:

- (1) Last day to withdraw with an automatic *W*: November 8, 2019 for undergraduate students and September 27, 2019 for graduate students.
- (2) Last day to withdraw without petition to the Dean: November 8, 2019 (for graduate students a *W/F* grade is assigned for withdrawals processed during the period September 30–December 6).
- (3) Labor day (no classes): September 2, 2019.
- (4) Thanksgiving vacation (no classes): November 27–December 1, 2019.
- (5) Last day of classes: December 6, 2019.

Policy on *W/I* grades: Through the end of the sixth week of the semester, students can withdraw from the course with an automatic *W*. Between the seventh and tenth weeks of the semester, undergraduate students can continue to withdraw with an automatic *W*, but graduate students must obtain the instructor's signature on the University's "drop form" to withdraw from the course, and along with the signature the instructor must indicate whether the student is passing or failing at the time of the withdrawal. After the tenth week of the semester, all students can only withdraw via petition to the Dean of their college. The petition process also requires the instructor's signature with a passing-failing indication at the time the petition is filed. Note that a "failing" indication on the petition means that even if the petition is approved the grade in the course will be weighted in the GPA as an *F*.

The grade of *I* is not intended to serve as a benign substitute for the grade of *F*, and is only given if a student has completed the majority of the work in the course at a passing level (for example everything except the final exam), the course work cannot be completed because of compelling and verifiable problem beyond the student's control, and the student expresses a clear intention of making up the missed work as soon as possible. Moreover, current OU policies require that instructors and the affected students execute a written "Incomplete Contract" before a grade of *I* can be given. The contract makes clear: (1) what work is to be made up; (2) when the make-up work must be completed (which cannot be more than one calendar year from the assignment of the *I*); and (3) *what alternative grade will be assigned if the make-up work is not completed*. If the make-up work specified in the contract is not made up within one calendar year, then the alternative grade specified in the contract will be entered on the student's transcript. Thus the *I* grade does not become permanent on the transcript if it is not made up within one year.

Academic Misconduct: All cases of suspected academic misconduct will be reported to the Office of Academic Integrity Programs as possible violations of University's Academic Integrity Code. If the violation is confirmed by the Academic Integrity Program's Office, the penalties can be quite severe, so the best advice is **Don't do it!** For more details on the University's policies concerning academic misconduct consult the link

<http://www.ou.edu/integrity>

This link also has information about admonitions (essentially warnings about potential misconduct for fairly minor infractions) and your rights to appeal charges of academic misconduct.

Students are also bound by the provisions of the *OU Student Code*, available at

<https://www.ou.edu/content/dam/studentlife/documents/AllCampusStudentCode.pdf>

Students with disabilities: The University of Oklahoma is committed to providing reasonable accommodation for all students with disabilities. Students with disabilities who require accommodations in this course are requested to speak with the instructor as early in the semester as possible. Prior to receiving accommodations in this course, students with disabilities must be registered with the Disability Resource Center, 730 College Avenue, phone 405–325–3852.