ÇANKAYA UNIVERSITY
Faculty of Arts and Sciences
Course Definition Form

Part I. Basic Course Information

Department Name	MATHEMATICS					**Dept. Numeric Code**	27
Course Code	MATH311	**Number of Weekly Lecture Hours**	3	**Number of Weekly Lab/Tutorial Hours**	0	**Number of Credit Hours**	3
Course Web Site	http:// math311.cankaya.edu.tr					**ECTS Credit**	05

Course Name *This information will appear in the printed catalogs and on the web online catalog.*	
English Name	Calculus of Variations
Turkish Name	Varyasyon Analizi

Course Description
Provide a brief overview of what is covered during the semester. This information will appear in the printed catalogs and on the web online catalog. Maximum 60 words.

Lagrange multipliers, Maxima and minima, the first variation. The Euler-Lagrange equations. Constraints. Natural and boundary conditions.Transversality conditions. The Hamiltonian formulation.

Prerequisites (if any) *Give course codes and check all that are applicable.*	1st	2nd	3rd	4th
	☐ Consent of the Instructor	☐ Senior Standing	☐ Give others, if any.	
Co-requisites (if any)	1st	2nd	3rd	4th
Course Type *Check all that are applicable*	☐ Must course for dept.	☐ Must course for other dept.(s)	☒ Elective course for dept.	☒ Elective course for other dept.(s)

Course Classification
Give the appropriate percentage for each category.

Category	Mathematics & Natural Sciences	Engineering & Architectural Sciences			
Percentage	80	20			

Part II. Detailed Course Information

Course Objectives
Maximum 100 words.

To teach students the necessary conditions for an extremal of a variational problem, namely the Euler-Lagrange equations. Study some geometrical problems and physical problems.

Learning Outcomes
Explain the learning outcomes of the course. Maximum 10 items.

1. The students will be able to obtain the Euler-Lagrange equations and solve them.
2. The students will realize how to generalize the optimization problem from the finite dimensional case to the infinite dimensional case.
3. The students will learn the Hamiltonian formulation.
4. The students will learn how to formalize some optimiztion problems into variational problems.
5. The students will be able to apply what they learn in differential equations course in solving the Euler-Lagrange equations.

Textbook(s)
List the textbook(s), if any, and other related main course material.

Author(s)	Title	Publisher	Publication Year	ISBN
Bruce Van Brunt	The Calculus of Variations	Springer	2004	0-387-40247-0

Reference Books
List, if any, other reference books to be used as supplementary material.

Author(s)	Title	Publisher	Publication Year	ISBN
I.M.Gelfand, S. V. Fomin	Calculus of Variations	Dove	2000	0-48641-448-5

Teaching Policy
Explain how you will organize the course (lectures, laboratories, tutorials, studio work, seminars, etc.)

3 hours of lecturing per week. Attendance to the lectures is compulsory.

Laboratory/Studio Work
Give the number of laboratory/studio hours required per week, if any, to do supervised laboratory/studio work and list the names of the laboratories/studios in which these sessions will be conducted.

Computer Usage
Briefly describe the computer usage and the hardware/software requirements for the course.

Course Outline
List the weekly topics to be covered.

Week	Topic(s)
1	Introduction (Functions of one and several variables), Lagrange multipliers
2	Maxima and Minima, Variational notation
3	The Euler Lagrange equations (ELE)
4	Special cases and a degenerate case of ELE
5	Invariance of the Euler-Lagrange Equations
6	Generalizations: Functionals containing several variables and higher order derivatives
7	The finite dimensional case and Lagrange multipliers. Single and multiple constraints. Abnormal problems
8	The isoperimetric problem (IP)
9	Generalizations of the IP
10	Problems with end variable points, natural boundary conditions and transition conditions
11	Transversality conditions
12	The Hamiltonian formulation
13	The Hamiltonian formulation
14	Review

Grading Policy
List the assessment tools and their percentages that may give an idea about their relative importance to the end-of-semester grade.

Assessment Tool	Quantity	Percentage	Assessment Tool	Quantity	Percentage	Assessment Tool	Quantity	Percentage
Homework	3	10	Case Study			Attendance		
Quiz(es)			Lab Work			Field Study		
Midterm Exam	2	50	Classroom Participation			Project		
Term Paper			Oral Presentation			Final Exam	1	40

ECTS Workload
List all the activities considered under the ECTS.

Activity	Quantity	Duration (hours)	Total Workload (hours)
Attending Lectures (*weekly basis*)	14	3	42
Attending Labs/Recitations (*weekly basis*)			
Compilation and finalization of course/lecture notes (*weekly basis*)	14	1	14
Collection and selection of relevant material (*once*)	1	5	5
Self study of relevant material (*weekly basis*)	14	1	14
Take-home assignments			
Preparation for quizzes			
Preparation for mid-term exams (*including the duration of the exams*)	2	15	30
Preparation of term paper/case-study report (*including oral presentation*)			
Preparation of term project/field study report (*including oral presentation*)			
Preparation for final exam (*including the duration of the exam*)	1	20	20
		TOTAL WORKLOAD / 25	125/25
		ECTS Credit	**5**

Total Workloads are calculated automatically by formulas. To update all the formulas in the document first press CTRL+A and then press F9.

Program Qualifications vs. Learning Outcomes *Consider the program qualifications given below as determined in terms of learning outcomes and acquisition of capabilities for all the courses in the curriculum. Look at the learning outcomes of this course given above. Relate these two using the Likert Scale by marking with X in one of the five choices at the right.*

No	Program Qualifications	Contribution				
		0	1	2	3	4
1	Adequate knowledge in mathematics; ability to use applied and theoretical information in these areas to solve pure and applied mathematical problems.					X
2	Ability to use modern computational tools to analyze an abstract or real life problem				X	
3	Adequate knowledge in theoretical and historical background in mathematics				X	
4	Ability to work individually and in teams efficiently, ability to collaborate effectively in teams to analyze complex systems from intra-disciplinary and multi-disciplinary areas				X	
5	Ability to communicate effectively in English about technical subjects, both orally and in writing				X	
6	Ability to use, develop and implement new experiments and algorithms to solve scientific, engineering and financial problems				X	
7	Ability to analyze a mathematical problem using both analytical and numerical methods; use and compare theoretical and simulational methods to gain deeper insight				X	
8	Ability to report the findings, conclusions and interpretations related to a project in the area of pure and applied mathematics, ability to write technical reports, to prepare and conduct effective presentations				X	
9	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to keep continuous self-improvement				x	
10	Awareness of professional and ethical responsibility issues and their legal consequences					x

Scale for contribution to a qualification: **0**-none, **1**-little, **2**-moderate, **3**-considerable, **4**-highest