ECE 5500: Nonlinear and Dynamic Programming for ECE

Course Description

Numerical optimization techniques as applied to selected electrical engineering application areas.

Prior Course Number: 759, 5759
Transcript Abbreviation: Optimization
Grading Plan: Letter Grade
Course Deliveries: Classroom, 100% at a distance
Course Levels: Undergrad, Graduate
Student Ranks: Senior, Masters, Doctoral
Course Offerings: Autumn
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 3.0 hr Lec
Expected out-of-class hours per week: 6.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: Prereq: 3050, or Grad standing in Engineering or Math and Physical Sciences.
Exclusions: Not open to students with credit for 759 or 5759.
Cross-Listings:

Course Rationale: This is an existing course, but the contents have been updated to omit duality and include more topics in dynamic optimization.

The course is required for this unit's degrees, majors, and/or minors: No
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.1001
Subsidy Level: Doctoral Course

Programs

Abbreviation	Description
CpE	Computer Engineering
EE	Electrical Engineering

Course Goals

Master computational and mathematical methods for optimization to solve engineering problems
Be competent with posing an engineering problem as an optimization problem
Be competent with arguing which algorithm is suitable for solving a given optimization problem
Be familiar with convergence techniques for optimization algorithms

Be exposed to modern software packages for numerical optimization

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Gradient methods, unconstrained and constrained: steepest descent, Newton's method, quasi-Newton method, projection, optimization over convex sets	12.0							
Problems with equality constraints, problems with inequality constraints, Lagrange multiplier and KKT Theorem	6.0							
Barrier method, method of multipliers, sequential quadratic programming, and Lagrangian algorithms for solving constrained optimization problems	8.0							
Applications in electrical and computer engineering: circuit design, communications, estimation, and/or electromagnetics	6.0							
Dynamic programming, Pontryagin maximum principle, approximate dynamic programming, model predictive control	8.0							

Representative Assignments

Homework problems from textbook
Midterm exam or project
Final exam or project

Grades

Aspect	Percent
Homework	50%
Midterm	30%
Final or Project	20%

Representative Textbooks and Other Course Materials

Title	Author
Nonlinear Programming	Dimitri P. Bertsekas

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
***	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics - pre-2019 EAC SLOs (a) and (e); (k) is implied
	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors - pre-2019 EAC SLO (c); (k) is implied
**	3	an ability to communicate effectively with a range of audiences - pre-2019 EAC SLO (g)
	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts - pre-2019 EAC SLOs (f) (h) and (j)

Course Contribution		College Outcome
	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives - pre-2019 EAC SLO (d)
**	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions - pre-2019 EAC SLO (b); (k) is implied
***	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies - pre-2019 EAC SLO (i)

CpE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
***	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
***	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
**	3	an ability to communicate effectively with a range of audiences
	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
*	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
***	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
***	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

EE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
***	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
***	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
**	3	an ability to communicate effectively with a range of audiences
	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
*	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
***	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
***	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Additional Notes or Comments

updated prereqs, exclusions, and goals to match university format.
Prereqs changed semicolon to comma (in university tool also) as requested by registrar

Update course goals and topics per internal ABET review 5/8/14 BLA

Edited text info, 5/10/17, CED

Update course goals, change prerequsite to 3050, add contributions to ne ABET outcomes 6/14/2019 BLA

Added more topics on dynamic optimization and omitted discussions on duality 11/20/2021 AG

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