TO: Dr. Hamid Rassoul, Dean, College of Science
FROM: Dr. Ugur Abdulla, Head, Mathematical Sciences Department
CC: Dr. Monica Baloga, Senior Vice President for Academic Affairs and Provost, Academic Affairs
Dr. Mark Archambault, Head, Undergraduate Curriculum Committee (UGCC)
DATE: January 12, 2017
RE: New Courses MTH1010, MTH 1020 and MTH 2107 for Fall 2017

The Department of Mathematical Sciences intends to offer three new courses starting in Fall 2017. The courses MTH1010 - Mathematical Analysis 1 and MTH1020 - Mathematical Analysis 2 will present a new proof-based rigorous Calculus sequence. In all three undergraduate math programs the requirement of MTH1001 - Calculus 1 and MTH1002 - Calculus 2 will be replaced with the requirement MTH1001 or MTH1010, and MTH1002 or MTH1020 respectively. This new Calculus sequence will significantly strengthen undergraduate math training at FIT. The new sequence is open for all FIT students and we anticipate that other science and engineering programs will apply the same flexibility for their degree required Calculus sequence.

The Department of Mathematical Sciences intends to offer new course MTH2107 - Optimization starting in Fall 2017. This course is open to all students at FIT as a MTH elective. It will be one of the restricted electives for math majors. This course will significantly strengthen undergraduate math training at FIT and will prepare our graduates equally well for postgraduate study or high tech industry employment.
**Florida Institute of Technology**

**ADDING A NEW COURSE TO THE CURRICULUM**

This is a request for reactivation of a course in the system.  □ Yes  ■ No

New courses are available beginning with the fall term in which they appear in the University Catalog.

<table>
<thead>
<tr>
<th>SUBJECT</th>
<th>COURSE NO.*</th>
<th>CREDIT HOURS</th>
<th>ACADEMIC YEAR TO BE ADDED TO THE FILE</th>
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<td>Fall 2017 (e.g., Fall 2010)</td>
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*Justify level if 1000-level+ and no co- or prerequisites

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| □ COLLEGE OF AERONAUTICS – 23 | ■ COLLEGE OF SCIENCE – 26 |
| □ NATHAN M. BISK COLLEGE OF BUSINESS – 24 | ■ EXTENDED STUDIES/NMB COLLEGE OF BUSINESS – 90 |
| □ COLLEGE OF ENGINEERING – 1 | ■ SCHOOL OF COMPUTING – 29 |
| □ COLLEGE OF PSYCHOLOGY AND LIBERAL ARTS – 25 | ■ SCHOOL OF HUMAN-CENTERED DESIGN, INNOVATION & ART – 28 |

| COMPUTER TITLE | Mathematical Analysis 1 |

This course will be entered into the system as:  □ Bi-Level  □ Cross-Listed  □ Dual-Numbered  □ Full-Load  □ None of these/Standard Listing  ■

| CATALOG TITLE | Mathematical Analysis 1 |

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<td>Provides a rigorous treatment of differential calculus. Emphasizes proofs. Includes functions and graphs, limits and continuity, differentiation, chain rule, Taylor's formula, calculation of the limit of a differentiable function, applications to maxima and minima, constructing the graph of a function and the Riemann integral.</td>
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This description has been approved by the catalog office  ■

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In addition, please attach a course syllabus and/or more detailed description.

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| ADDITIONAL RESTRICTION □ and □ or TMTH (placement) score of 32 or above |
| (e.g., Major, Class Level, Department Head Approval) |

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<tr>
<td>□ Other</td>
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If this course replaces a course currently offered in BANNER, please indicate old course information and the date/term the course may be removed from the system.

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□ Yes  ■ No  Will this course be used to measure program-level student learning outcomes? If yes, review and signature required.**

□ Yes  ■ No  Will this course be used to satisfy the scholarly inquiry requirement? If yes, attach "O" materials for review.

□ Yes  ■ No  Will this course impact any existing programs? If yes, attach "Changing Graduation Requirements" form for each program impacted.

**APPROVALS: On completion of description and course number verification, affix appropriate signatures as indicated, and submit to the Office of Graduate Programs, or Undergraduate Curriculum Committee Chair for placement on agenda.

<table>
<thead>
<tr>
<th>Originator</th>
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<tr>
<th>Department Head/Program Chair</th>
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<tr>
<th>Dean or Associate Dean</th>
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**Chief Academic Officer  Date  

**CATALOG & CURRICULUM MANAGER**

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**REGISTRAR’S USE ONLY**

SCACRSE  SCADETL  SCAPREQ  SCBASE  ACALOG  SCABRES  CIP Code  Operator Init.  Date

Florida Institute of Technology • Office of the Registrar

150 West University Boulevard, Melbourne, FL 32901-6975 • (321) 674-8114 • Fax (321) 674-7827

RGR-297-818
MTH 1010 ‘Mathematical Analysis 1’ Fall 2017 (August – December)
TBA, Office: TBA (Department of Mathematical Sciences), Phone: extension xxx, e-mail: xxx@fit.edu
- Lecture: M W ; T R
- Office Hours: T R

**TEXTBOOK**

**Real numbers**
1) Definition of the set of real numbers;
2) Basic lemmas (Nested interval, Finite covering, Limit point)
3) Countable and uncountable sets

**Limits**
1) The limit of a sequence: definitions and properties
2) Existence of the limit of a sequence
3) The limit of a function: definitions and properties
4) Existence of the limit of a function

**Continuous functions**
1) Continuity of a function at a point
2) Points of discontinuity
3) Local properties of a continuous function
4) Global properties of a continuous function

**Midterm Test 1**

**Differential Calculus**
1) Functions differentiable at point
2) Tangents. Geometric meaning of the derivative
3) Differentiation of a composite function (chain rule)
4) Differentiation of an inverse function
5) Table of derivatives of elementary functions
6) Higher order derivatives
7) Fermat’s lemma and Rolle’s theorem
8) Mean–value theorems of Lagrange and Cauchy
9) Taylor’s formula

**Midterm Test 2**

**Differential Calculus used to Study Functions**
1) Conditions for a function to be monotonic
2) Conditions for an interior extremum of a function
3) Conditions for a function to be convex
4) L’Hopital’s rule
5) Constructing the graph of a function
Primitive
  1) The primitive and the indefinite integral
  2) The basic general methods of finding a primitive

Midterm Test 3

Integration
  1) Definition of the Riemann integral
  2) Properties of the integral: linearity, additivity, monotonicity
  3) The mean–value theorem
  4) The integral and the primitive
  5) The Newton–Leibniz formula (Fundamental Theorem of Calculus)

Final Exam

Grading: Your course grade will be based on a cumulative quiz grade (100 pts), homework (50 pts), projects (50 pts), 3 midterm exams (100 pts each) and a final exam (200 pts). Hence there are 700 possible course points. The quiz grade will be sum of the best 10/11 weekly quiz scores. Quizzes will be given on Tuesdays. Only students with excused absences may make-up work- no exceptions (consult your student handbook). An excused absence requires either a University excuse or official documentation, e.g. a doctor’s note. ATTENDANCE IS REQUIRED.
MATHEMATICAL ANALYSIS 1, MTH 1010, Fall 2017

Instructor: TBA

Textbook: *Calculus, 4th Edition*, by M. Spivak, Publish or Perish (Required)

*Mathematical Analysis I*, by V. A. Zorich, Springer (Recommended)

**Course Information.** This course is a rigorous, proof based version of Calculus 1, MTH1001, with emphasis on theoretical aspects and proofs of classical theorems of differential and integral calculus. The course includes real numbers, limits and continuity, differentiation and Riemann Integral. Students enrolled in the course will be periodically tested by means of homework assignments, projects, quizzes and tests. Precalculus, MTH1000 is the prerequisite for the course.

**Expected Outcomes.** Upon the completion of the course students will learn theoretical aspects of the differential calculus and the basic properties of Riemann integral. Students will learn how to prove various classical theorems on continuous and differentiable functions.

In a nutshell,

- Students will learn the fundamental concepts of analysis such as limits and continuity;
- Students will learn properties of continuous functions by proving classical theorems of Bolzano-Cauchy, Cantor and Weierstrass;
- Students will learn the fundamental properties of differentiable functions by proving mean-value theorems of Rolle, Lagrange and Cauchy;
- Students will learn higher order derivatives and prove Taylor’s formula;
- Students will learn in details the properties of elementary functions, such as trigonometric, inverse trigonometric, exponential and logarithmic functions, to name a few;
- Students will learn how to calculating the limit of a differentiable function by means of L’Hopital’s rule and the Taylor’s expansion technique;
- Students will learn how to investigate a function and construct its graph using the results of differential calculus;
- Students will learn the definition and basic properties of Riemann integral.
Course Description and Schedule

- **Weeks 1-2. Real Numbers**: Definition of the set of real numbers; 2) Basic lemmas (Nested interval, Finite covering, Limit point), Countable and uncountable sets

- **Week 3. Limits**: The limit of a sequence: definitions and properties; Existence of the limit of a sequence; The limit of a function: definitions and properties; Existence of the limit of a function.

- **Weeks 4-5. Continuous functions**: Continuity of a function at a point, Points of discontinuity; Local properties of a continuous function; Global properties of a continuous function.

  **Midterm Test 1**

- **Weeks 6-9. Differential Calculus**: Functions differentiable at point; Tangents, Geometric meaning of the derivative; Differentiation of a composite function (chain rule); Differentiation of an inverse function; Table of derivatives of elementary functions; Higher order derivatives; Fermat's lemma and Rolle's theorem; Mean--value theorems of Lagrange and Cauchy; Taylor's formula.

  **Midterm Test 2**

- **Weeks 10-11. Differential Calculus Used to Study Functions**: Conditions for a function to be monotonic; Conditions for an interior extremum of a function; Conditions for a function to be convex; L'Hopital's rule; Constructing the graph of a function

- **Weeks 12. Primitive**: The primitive and the indefinite integral; The basic general methods of finding a primitive.

  **Midterm Test 3**

- **Weeks 13-15. Integration**: Definition of the Riemann integral; Properties of the integral: linearity, additivity, monotonicity; The mean--value theorem; The integral and the primitive; The Newton--Leibniz formula (Fundamental Theorem of Calculus).

  **Final Exam**
**Grading:** Grade will be based on a cumulative quiz grade (100pts), homework (50 pts), projects (50 pts), 3 midterm exams (100 pts each) and a final exam (200 pts).
### Adding a New Course to the Curriculum

This is a request for reactivation of a course in the system. **Yes** ☐ **No** ☐

**New courses are available beginning with the fall term in which they appear in the University Catalog.**

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- Justify level if 1000-level and no co- or prerequisites

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**DEPARTMENT:** Mathematical Sciences

- COLLEGE OF AERONAUTICS – 23
- NATHAN M. BISK COLLEGE OF BUSINESS – 24
- COLLEGE OF ENGINEERING – 1
- COLLEGE OF PSYCHOLOGY AND LIBERAL ARTS – 25

- COLLEGE OF SCIENCE – 26
- EXTENDED STUDIES/NMB COLLEGE OF BUSINESS – 90
- SCHOOL OF COMPUTING – 29
- SCHOOL OF HUMAN-CENTERED DESIGN, INNOVATION & ART – 28

**COMPUTER TITLE:** Mathematical Analysis 2

- Restricted to 25 characters, including spaces

**CATALOG TITLE:** Mathematical Analysis 2

- Restricted to 350 characters, including spaces

Provides a rigorous treatment of integral calculus. Emphasizes proofs. Includes integration and applications of integration, further techniques of integration, improper integrals, integrals depending on a parameter, sequences and series, uniform convergence of series and improper integrals.

This description has been approved by the catalog office, **Emory 1/12/2017**

**In addition, please attach a course syllabus and/or more detailed description.**

**GRADES TO BE ISSUED:**

- A, B, C, D, F
- A, B, C, D, F, CEU/Audit
- CEU
- S, U
- P, F
- Other

**RESTRICTIONS**

- Prerequisite MTH 1010
- Corequisite

**ADDITIONAL RESTRICTION**

- and or (e.g., Major, Class Level, Department Head Approval)

If this course replaces a course currently offered in BANNER, please indicate old course information and the date/term the course may be removed from the system.

**SUBJECT**

- Alpha Prefix (e.g., CSE)
- COURSE NO. (e.g., 1301)
- TERM TO INACTIVATE

- Yes ☐ No ☐ Will this course be used to measure program-level student learning outcomes? If yes, review and signature required.

- Yes ☐ No ☐ Will this course be used to satisfy the scholarly inquiry requirement? If yes, attach "O" materials for review.

- Yes ☐ No ☐ Will this course impact any existing programs? If yes, attach "Changing Graduation Requirements" form for each program impacted.

**APPROVALS:** On completion of description and course number verification, affix appropriate signatures as indicated, and submit to the Office of Graduate Programs, or Undergraduate Curriculum Committee Chair for placement on agenda.

**Originator**

Date

**Chair, Graduate Council**

Date

**Department Head/Program Chair**

Date

**Dean or Associate Dean**

Date

**Chair, Undergraduate Curriculum Committee**

Date

**Chief Academic Officer**

Date

**CATALOG & CURRICULUM MANAGER**

These changes/additions have been made for the University Catalog and entered into the BANNER term named above.

**Registrar’s Use Only**

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Florida Institute of Technology • Office of the Registrar

150 West University Boulevard, Melbourne, FL 32901-6975 • (321) 674-814 • Fax (321) 674-7827

RGR-297-816
MTH 1020 ‘Mathematical Analysis 2’ Spring 2018 (January –April)
TBA, Office: TBA (Department of Mathematical Sciences), Phone: extension xxxx, e-mail: xxxx
• Lecture: M W; T R
• Office Hours: T R

• TEXTBOOK

The Integral and the Derivative
  1) Properties of the integral (review of the material from Honors Calculus 1);
  2) Integration by parts and Taylor’s formula
  3) Change of variable in an integral

Application of Integration
  1) Arc length
  2) The area of a curvilinear trapezoid
  3) Volume of a solid of a revolution
  4) Work and Energy

Midterm Test 1

Improper Integrals
  1) Definition, examples, and basic properties
  2) Convergence of an improper integral
  3) Improper integrals with more than one singularity

Uniform Convergence and Basic Operations of Analysis
  1) Pointwise and uniform convergence
  2) Convergence of a family depending on a parameter
  3) The Cauchy criterion of uniform convergence
  4) Uniform convergence of series of functions
  5) Weierstrass M-test for uniform convergence
  6) The Abel–Dirichlet test

Midterm Test 2

Functional Properties of a Limit Function
  1) Continuity and passage to the limit
  2) Integration and passage to the limit
  3) Differentiation and passage to the limit
  4) Power series

Proper Integrals Depending on a Parameter
  1) Continuity of the integral
  2) Differentiation of the integral
  3) Integration of the integral
Midterm Test 3

Improper Integrals Depending on a Parameter
  1) Uniform convergence with respect to a parameter
  2) Continuity of an integral depending on a parameter
  3) Differentiation with respect to a parameter
  4) Integration of an improper integral
  5) The Eulerian integrals: the Beta and Gamma functions
  6) Connection between the Beta and Gamma functions

Final Exam

Grading: Your course grade will be based on a cumulative quiz grade (100 pts), homework (50 pts), projects (50 pts), 3 midterm exams (100 pts each) and a final exam (200 pts). Hence there are 700 possible course points. The quiz grade will be sum of the best 10/11 weekly quiz scores. Quizzes will be given on Tuesdays. Only students with excused absences may make-up work- no exceptions (consult your student handbook). An excused absence requires either a University excuse or official documentation, e.g. a doctor’s note. ATTENDANCE IS REQUIRED.
MATHEMATICAL ANALYSIS 2, MTH 1020, Spring 2018

Instructor: TBA

Textbook: *Calculus, 4th Edition*, by M. Spivak, Publish or Perish (Required)

*Mathematical Analysis I & II*, by V. A. Zorich, Springer (Recommended)

**Course Information.** This course is a rigorous, proof based version of Calculus 2, MTH1002, with emphasis on theoretical aspects and proofs of classical theorems of differential and integral calculus. The course includes integration and applications of integration, improper integrals, functional series, power series, uniform convergence, convergence test for series and improper integrals, integrals depending on a parameter. Students enrolled in the course will be periodically tested by means of homework assignments, projects, quizzes and tests. Calculus/Analysis 1, MTH1010 is the prerequisite for the course.

**Expected Outcomes.** Upon the completion of the course students will learn theoretical aspects of the differential and integral calculus. Students will learn the fundamental properties of the Riemann integral and its applications.

In a nutshell,

- Students will learn different techniques of integration;
- Students will learn different applications of integration in geometry and physics;
- Students will learn the concept of uniform convergence for functional sequences and series;
- Students will learn the properties of power series, in particular its interval and radius of convergence;
- Students will learn various convergence tests for functional series, in particular Weierstrass’ M-test and the Abel-Dirichlet test;
- Students will learn the properties of integrals depending on a parameter;
- Students will learn the Eulerian integrals: the *Beta* and *Gamma* functions.
Course Description and Schedule

- **Weeks 1-2. The Integral and the Derivative**: Properties of the integral (review of the material from Honors Calculus 1); Integration by parts and Taylor's formula; Change of variable in an integral.

- **Week 3. Some Application of Integration**: Arc length; The area of a curvilinear trapezoid; Volume of a solid of a revolution; Work and Energy.

  **Midterm Test 1**

- **Weeks 4-5. Improper Integrals**: Definition, examples, and basic properties; Convergence of an improper integral; Improper integrals with more than one singularity.

- **Weeks 6-8. Uniform convergence and Basic Operations of Analysis**: Pointwise and uniform convergence; Convergence of a family depending on a parameter; The Cauchy criterion of uniform convergence; Uniform convergence of series of functions; Weierstrass M-test for uniform convergence; The Abel–Dirichlet test.

  **Midterm Test 2**

- **Weeks 9-10. Functional Properties of a Limit Function**: Continuity and passage to the limit; Integration and passage to the limit; Differentiation and passage to the limit; Power series.

- **Weeks 11-12. Proper Integrals Depending on a Parameter**: Continuity of the integral; Differentiation of the integral; Integration of the integral.

  **Midterm Test 3**

- **Weeks 13-15. Improper Integrals Depending on a Parameter**: Uniform convergence with respect to a parameter; Continuity of an integral depending on a parameter; Differentiation with respect to a parameter; Integration of an improper integral; The Eulerian integrals: the Beta and Gamma functions; Connection between the Beta and Gamma.

  **Final Exam**
**Grading:** Grade will be based on a cumulative quiz grade (100pts), homework (50 pts), projects (50 pts), 3 midterm exams (100 pts each) and a final exam (200 pts).
This is a request for reactivation of a course in the system.  □ Yes  □ No

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CLASS HOURS 45 / semester  LECTURE HOURS 45 / semester  LAB HOURS 0 / semester  CONTACT HOURS (CEU ONLY) N/A

DEPARTMENT Mathematical Sciences  SCHEDULE TYPE Lecture (A)

□ COLLEGE OF AERONAUTICS - 23  □ COLLEGE OF SCIENCE - 26
□ NATHAN M. BISK COLLEGE OF BUSINESS - 24  □ EXTENDED STUDIES/NMB COLLEGE OF BUSINESS - 90
□ COLLEGE OF ENGINEERING - 1  □ SCHOOL OF COMPUTING - 29
□ COLLEGE OF PSYCHOLOGY AND LIBERAL ARTS - 25  □ SCHOOL OF HUMAN-CENTERED DESIGN, INNOVATION & ART - 28

COMPUTER TITLE Optimization  Restricted to 25 characters, including spaces

This course will be entered into the system as: Bi-Level □ Cross-Listed □ Dual-Numbered □ Full-Load □ None of these/Standard Listing □

CATALOG TITLE Optimization

CATALOG DESCRIPTION OF COURSE
Provides a rigorous introduction to the fundamental theory of optimization. Includes linear programming, duality, sensitivity, convex analysis, nonlinear optimization, optimal control and Pontryagin's maximum principle. Emphasizes problem formulation, analytical theory, algorithmic methods and recent applications.

This description has been approved by the catalog office 1/2/2017

In addition, please attach a course syllabus and/or more detailed description.

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<td>MTH 2201</td>
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ADDITIONAL RESTRICTION □ Major □ Class Level □ Department Head Approval

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□ Yes  □ No  Will this course be used to satisfy the scholarly inquiry requirement? If yes, attach “Q” materials for review.

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APPROVALS: On completion of description and course number verification, affix appropriate signatures as indicated, and submit to the Office of Graduate Programs, or Undergraduate Curriculum Committee Chair for placement on agenda.

Originator  Date  Chair, Graduate Council  Date

Department Head/Program Chair  Date  OR

Dean or Associate Dean  Date  Chair, Undergraduate Curriculum Committee  Date

**Chief Academic Officer  Date

CATALOG & CURRICULUM MANAGER  REGISTRAR’S USE ONLY

These changes/additions have been made for the University Catalog and entered into the BANNER term named above.

SCACRSE  SCADETL  SCAPREQ  SCABLE  SCBASE  ACALOG

SCARRSES  CIP Code  Operator Init.  Date

Catalog & Curriculum Manager  Date
OPTIMIZATION
MTH 3107
Section 01 – Fall 2017

Time and Location: TBA

Lecturer: TBA

Email: TBA
Office: TBA
Office Hours: TBA

Prerequisites: MTH 2001 - Calculus 3 and MTH 2201 - Differential Equations/Linear Algebra

Requirement: Experience with mathematical modeling and/or basic knowledge of computer programming is a plus.


Course Description: This course provides a rigorous introduction to the fundamental theory of optimization. Topics include linear programming, convex analysis, nonlinear optimization, optimal control and Pontryagin’s maximum principle. The main emphasis is on solution techniques and analysis of the underlying mathematical structure of optimization problems together with their applications to real-world problems.

Course Objectives: The field of optimization provides an elegant blend of theory, beginning with elementary calculus and linear algebra and continuing with functional and convex analysis and offers various applications in diverse areas such as science, engineering, economics, finance, health-care, and statistics. The course aims to equip students with practical optimization methods for solving real-world applications and prepare them for a career in academia and industry. The objectives of this course are to help students

• Develop a knowledge of the underlying mathematical foundations of commonly used optimization models;
• Learn theory, algorithms, and applications of discrete optimization models;
• Develop a knowledge of the principles of optimal control and approaches based on Pontryagin’s maximum principle;
• Develop insight into the interplay between geometry of linear and nonlinear programs and their solution methods;
• Learn and apply algorithmic and computational techniques for solving linear and nonlinear programs;
• Understand the derivation and comparative advantages of methods for solving optimization programs;
• Cultivate an ability to mathematically model complex systems occurring in real-world applications as optimization problems;
• Gain familiarity with commonly used optimization packages.

**Course Outline:** This course serves as an introduction to a wide variety of optimization problems and techniques. The course outline is:

**Week 1.** Introduction
- Maximization/Minimization of functions of single variables
- Examples of Optimization Models
- Mathematical Foundations: Vectors and Matrices, Hyper-planes, Half-spaces, and Cones
- Fundamentals of Optimization: Feasibility, Optimality, and Convexity

**Weeks 2–3.** Linear Programming
- The Geometry of Linear Programs: Extreme Points, Vertices, and Basic Feasible Solutions
- The Simplex Method
- Revised Simplex Method; Tableau Implementation
- Two-Phase Simplex Methods
- Degeneracy and Anti-Cycling Methods

**Weeks 3–4.** Linear Optimization Duality
- Farkas’ Lemma
- Weak Duality; Strong Duality; Complementary Slackness
- The Dual Simplex Method: Tableau Implementation
- Sensitivity Analysis

**Weeks 5–6.** Unconstrained Nonlinear Optimization
- Nonlinear Optimization Models and Applications
- Convex Analysis
- Minimization of Functions of Several Variables
- Necessary and Sufficient Conditions for Optimality
Weeks 7–8.  Unconstrained Nonlinear Optimization Methods  
• Newton’s Method for Minimization and Convergence  
• Line-Search Methods  
• Steepest Descent Method and Convergence  
• Conjugate-Gradient Methods  
• Other Gradient Methods for Unconstrained Optimization

Weeks 9–10.  Constrained Nonlinear Optimization  
• Optimality Conditions for Linearly Constrained Optimization  
• Lagrange Multipliers and the Lagrangian Function  
• Optimality Conditions for Nonlinearly Constrained Optimization

Weeks 11–12.  Nonlinear Optimization Duality  
• Lagrangian Duality; Weak Duality  
• Penalty and Barrier Methods  
• Nonlinear Primal-Dual Interior Point Method  
• Convergence of the Primal-Dual Interior Point Method

• Mathematical Formulation of the Control Problem  
• Calculus of Variations vs Optimal Control  
• Controllability, Bang-Bang principle  
• Pontryagin’s Maximum Principle and Applications

Grading: The term grade will be based on the results of the examinations and the scores on written homework and projects. Homework assignments will be posted weekly on CANVAS. Projects may will involve the implementation of optimization models and solutions using an optimization package, be of theoretical nature, or combination of both. There will be two midterm exams and a cumulative final exam. Students must cite any external references used to improve their understanding of the course material, homework, and projects. The components of the term grade and the grading scheme are given below:

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Additional Resources:

- Linear/Nonlinear Optimization

- Optimal Control

- Optimization Software
  - FICO Xpress Optimization Suite – Student Edition
  - IBM ILOG CPLEX Optimization Studio


The addition or removal of any graduation requirement in a major or minor requires that this form, accompanied by supporting documentation, be completed and approved as indicated below. Incomplete or incorrect forms will not be processed.

**COLLEGE**  College of Science  
**DEPARTMENT**  Mathematical Sciences  

**DEGREE LEVEL**  Undergraduate  
**PROGRAM TITLE**  Mathematical Sciences - Applied Mathematics  

**TO BE INITIATED WITH CATALOG YEAR**  2017 / 2018  
**CHANGE REQUESTED FOR**  
□ major program  
□ minor program  
**Major/Minor Code**  7077  

Program changes are effective beginning with the fall term in which they appear in the University Catalog.

☐ Yes  □ No  
Will this change impact the program’s assessment process? If yes, attach a description of how the assessment will be impacted and the new process.

**DESCRIPTION OF REQUESTED CHANGES**  
Attach a more detailed description and any supporting documentation

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**Requirement MTH 1001-Calculus 1 changing to requirement MTH 1001-Calculus 1 or MTH1010-Mathematical Analysis 1**

**Requirement MTH 1002-Calculus 2 changing to MTH 1002-Calculus 2 or MTH 1020-Mathematical Analysis 2.**

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**Approvals:** On completion of appropriate department approvals, submit form to Chair, Graduate Council, or Chair, Undergraduate Curriculum Committee, for approval below and forward to the Catalog & Curriculum Manager.

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TO BE INITIATED WITH CATALOG YEAR 2017-2018

CHANGE REQUESTED FOR: [ ] major program [ ] minor program

Major/Minor Code

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Requirement MTH 1002-Calculus 2 changing to MTH 1002-Calculus 2 or MTH 1020-Mathematical Analysis 2.

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