**Istituto Lorenzo de' Medici**

**2019 Summer Program**

**MATH 200 Linear Algebra and Differential Equations**

**Course Outline**

**Term: June 17-July 19, 2019**

**Class Hours: 12:00 - 13:50PM (Monday through Friday)**

**Course Code: MATH 200**

**Instructor: TBA**

**Office Hours: TBA**

**Email: TBA**

**Credit: 4**

**Class Hours:** This course will have 72 class hours, including 40 lecture hours, professor 10 office hours, 10-hour TA discussion sessions, 2-hour review sessions, 10-hour extra classes.

**Course Description:**

This is a lower division course in linear algebra and differential equations. Linear algebra is one of the fundamental tools in mathematics. The theory was first developed to study the systems of linear equations. The obtained tools ended up being useful in studying differential equations, operator theory, quantum mechanics, probability theory, combinatorics, and almost every other branch of mathematics, physics, and computer science.

Differential equations are equations involving functions and their derivatives. They appear frequently in physics, biology, and economics when complicated processes are approximated with mathematical models. We will learn how to solve first and second order differential equations, linear systems, and certain partial differential equations.

We will start with an introduction of vector spaces. Then we will introduce linear transformations, their matrices, and determinants. We will further study linear transformations and operators, their characteristic and minimal polynomials, spectral theorems, diagonal and Jordan forms. The course will then proceed to the study of differential equations. The course will finish with the study of quadratic forms, Hermitian spaces, and Hilbert spaces.

**Required Textbooks:**

David C. Lay: Linear Algebra and Its Applications, 3rd edition
Willian E. Boyce, Richard C. DiPrima: Elementary Differential Equations and Boundary Value Problems, 7th edition

**Grading & Evaluation:**

Homework and quizzes: 30%
Midterm: 30%
Final: 40%

**Course Schedule:**

**Week 1:**

Session 1: Introduction. Linear independence.

Session 2: Linear transformations. Composition.

Sessions 3: Inverse. Determinant.

**Week 2:**

Session 1: Vector spaces.

Session 2: Kernels and ranges. Bases. Rank theorem.

Session 3: Matrix of a transformation. Eigenvalues and eigenvectors.

**Week 3:**

Session 1: Diagonal operators. Spectral theorem.

Session 2: Dot Product. Orthogonal decomposition.

Session 3: Least squares. Symmetric matrices.

**Week 4:**

Session 1: Exponential function and mass on a spring. Second order Homogenous and non-homogenous equations.

Session 2: Higher order equations. Systems of linear differential equations.

Session 3: Matrix exponential. Heat equation. Wave equation.

**Week 5:**

Session 1: Fourier series.

Session 2: Laplace's equation.

Session 3: Review.