**University of Nicosia, Cyprus**

| **Course Code** | **Course Title** | **ECTS Credits** |
|---|---|---|
| MATH-193 | Calculus for the Life Sciences II | 6 |
| **Department** | **Semester** | **Prerequisites** |
| Computer Science | Fall, Spring | MATH-192 |
| **Type of Course** | **Field** | **Language of Instruction** |
| Required | Mathematics | English |
| **Level of Course** | **Year of Study** | **Lecturer(s)** |
| 1st Cycle | 1st or 2nd | Dr Nectarios Papanicolaou |
| **Mode of Delivery** | **Work Placement** | **Co-requisites** |
| Face-to-face | N/A | None |

**Objectives of the Course:**

The main objectives of this course are to:

- Provide students with a comprehensive and practical working knowledge of the basic theory of matrices and its application to biological problems
- Cover additional integration techniques (integration by parts, partial fractions)
- Introduce students to differential equations and initial value problems
- Provide students with the necessary techniques (integrating factor, separation of variables) to solve first-order equations
- Discuss the applications of differential equations in Biological models
- Introduce students to autonomous equations and stability theory. Discuss applications in population dynamics
- Cover in detail methods of solving second order equations with constant coefficients

**Learning Outcomes:**

After completion of the course students are expected to be able to:

1. Carry out matrix operations and use matrix theory to solve linear systems of equations.
2. Compute the eigenvalues and eigenvectors of a matrix
3. Calculate the solution of linear second order difference equation
4. Apply linear systems theory in biological models
5. Apply integration techniques to evaluate definite and indefinite integrals
6. Solve and interpret differential equations.
7. Use differential equations to approximate changes of exponential and logarithmic functions in biological models of growth and decay.
8. Use elementary stability theory to analyze, compare and contrast mathematical models for some select biological and medical phenomena.

**Course Contents:**

1. Matrices
    a. Matrix Operations
    b. Solution of Linear Systems. Gauss-Jordan Elimination
    c. The Inverse of a Matrix
    d. Determinants
    e. Eigenvalues and Eigenvectors
    f. Difference Equations
2. Integration
    a. Review of Integration Techniques
    b. Integration by Parts
    c. Integration Using Partial Fractions
3. First-Order Differential Equations
    a. Introduction to Differential Equations and Initial Value Problems
    b. First Order Linear Equations. The method of the Integrating Factor
    c. Separation of Variables
    d. Population Dynamics. Logistic Growth Models
    e. Elements of Stability theory. Introduction to the Theory of Autonomous Systems
    f. Calculus Applications in Biological Data Interpretation
4. Second Order Differential Equations
    a. Homogeneous Equations with Constant Coefficients
    b. Non-Homogeneous Equations. The method of Undetermined Coefficients
    c. Differential equations and systems
5. Higher Order Linear Equations

**Learning Activities and Teaching Methods:**

Lectures, Homework

**Assessment Methods:**

Assignments, quizzes, two mid-term exams, and a final exam

**Required Textbooks/Reading:**

| Authors | Title | Publisher | Year | ISBN |
|---|---|---|---|---|
| M. L. Bittinger, N.Brand, J.Quintanila | Calculus for the Life Sciences. | Addison Wesley | 2006 | 0321279352 |

**Recommended Textbooks/Reading:**

| Authors | Title | Publisher | Year | ISBN |
|---|---|---|---|---|
| Howard Anton, Ir Irl Bivens, Stephe Davis | Calculus: Late Transcendentals Combined (or Single Variable) *9th Edition* | Wiley | 2009 | 0470183497 |

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|---|---|---|---|---|
| William Boyce, Richard Di Prima | Elementary Differential Equations *9th Edition* | Wiley | 2009 | 047003940X |
| Frederick R. Adle | Modeling the Dynamics of Life: Calculus and Probability for Life Scientists *2nd Edition* | Brooks/Cole | 2004 | 0534404863 |
| Claudia Neuhauser | Calculus for biology and medicine *3rd Edition* | Prentice-Hall | 2010 | 0321644689 |