MATH 340: Applied Numerical Methods

Spring 2022 Course Syllabus

Please also see the Math 340 Syllabus Introduction on the course canvas page

NJIT Academic Integrity Code: All Students should be aware that the Department of Mathematical Sciences takes the University Code on Academic Integrity at NJIT very seriously and enforces it strictly. This means that there must not be any forms of plagiarism, i.e., copying of homework, class projects, or lab assignments, or any form of cheating in quizzes and exams. Under the University Code on Academic Integrity, students are obligated to report any such activities to the Instructor.

Please be sure you read and fully understand our DMS Online Exam Policy.

COURSE INFORMATION

Course Description: Introduction to numerical methods with emphasis on mathematical models. Implements and investigates numerical techniques for the solution of linear and nonlinear systems of equations, eigenvalue problems, interpolation and approximation, techniques of optimization, Monte Carlo methods, and applications to ordinary differential equations and integration.

Number of Credits:

Prerequisites: MATH 211 with a grade of C or better or MATH 213 with a grade of C or better, and CS 100 with a grade of C or better or CS 101 with a grade of C or better or CS 113 with a grade of C or better or CS 115 with a grade of C or better or MATH 240 with a grade of C or better.

Course-Section and Instructors:

Course-Section	Instructor
Math 340-002	Professor B. Bukiet
Math 340-004	Professor B. Bukiet

Office Hours for All Math Instructors: Spring 2022 Office Hours and Emails

Required Textbook:

Title	*Numerical Analysis*
Author	Timothy Sauer
Edition	3rd
Publisher	Pearson

ISBN #	978-0134696454
Website(s)	http://web.njit.edu/~bukiet See course Canvas page for course learning objects Resource: http://web.njit.edu/~bukiet/M611/M611.html

University-wide Withdrawal Date: The last day to withdraw with a **W** is **Monday, April 4, 2022**. It will be strictly enforced.

COURSE GOALS

Course Outcomes

Students will demonstrate the ability to:

- Analyze errors arising in numerical computation of solutions to mathematical and applied problems.
- Apply numerical techniques to compute approximate solutions of nonlinear equations and differential equations and analyze error issues.
- Apply numerical techniques for interpolation, differentiation and quadrature problems and analyze error issues.
- Communicate advantages and disadvantages of various numerical techniques and select appropriate numerical methods to solve specific problems.
- Translate numerical problems and methods into computational algorithms, apply the algorithms and develop conclusions from the output.
- Articulate connections among course material, their other courses, their majors and/or their prospective careers

Course Assessment: The assessment of outcomes will be achieved through homework, MATLAB assignments, quizzes, and exams.

POLICIES

DMS Course Policies: All DMS students must familiarize themselves with, and adhere to, the Department of Mathematical Sciences Course Policies, in addition to official university-wide policies. DMS takes these policies very seriously and enforces them strictly.

Grading Policy: The final grade in this course will be determined as follows:

Homework, Quizzes, Lab, (optional) Project, and Class Participation	25%
Midterm Exams (4)	30% - 60%
Final Exam	15% - 45%
Project (for Honors)	25% (total out of 125%)

Your final letter grade will be based on the following tentative curve.

A	90 - 100	**C**	70 - 75
B+	86 - 89	**D**	60 - 69

B	80 - 85	**F**	59 and below
C+	76 - 79		

Attendance Policy: Attendance at all classes will be recorded and is **mandatory**. Please make sure you read and fully understand the Math Department's Attendance Policy. This policy will be strictly enforced.

Homework: Homework assignments REQUIRE use of MATLAB software.

Exams: There will be four exams during the semester and a final exam during the final exam week. The tentative dates are:

Midterm Exam I	February 14, 2022
Midterm Exam II	March 9, 2022
Midterm Exam III	April 4, 2022
Midterm Exam IV	April 27, 2022
Final Exam Period	May 6 - May 12, 2022

The final exam will test your knowledge of all the course material taught in the entire course. Make sure you read and fully understand the Math Department's Examination Policy. This policy will be strictly enforced.

Makeup Exam Policy: There will be **NO MAKE-UP QUIZZES OR EXAMS** during the semester. In the event an exam is not taken under rare circumstances where the student has a legitimate reason for missing the exam, the student should contact the Dean of Students office and present written verifiable proof of the reason for missing the exam, e.g., a doctor's note, police report, court notice, etc. clearly stating the date AND time of the mitigating problem. The student must also notify the Math Department Office/Instructor that the exam will be missed.

Cellular Phones: All cellular phones and other electronic devices must be switched off during all class times.

ADDITIONAL RESOURCES

Math Tutoring Center: Located in the Central King Building, Lower Level, Rm. G11 (See: Spring 2022 Hours)

Further Assistance: For further questions, students should contact their instructor. All instructors have regular office hours during the week. These office hours are listed on the Math Department's webpage for Instructor Office Hours and Emails.

Accommodation of Disabilities: The Office of Accessibility Resources and Services (OARS) offers long term and temporary accommodations for undergraduate, graduate and visiting students at NJIT.

If you are in need of accommodations due to a disability please contact Scott Janz, Associate Director of Disability Support Services at 973-596-5417 or via email at scott.p.janz@njit.edu. The office is located in Kupfrian Hall, Room 201. A Letter of Accommodation Eligibility from the Office of Accessibility Resources and Services office authorizing your accommodations will be required.

For further information regarding self identification, the submission of medical documentation and additional support services provided please visit the Office of Accessibility Resources and Services (OARS)

website at:

https://www.njit.edu/studentsuccess/accessibility/

Important Dates (See: Spring 2022 Academic Calendar, Registrar)

Date	Day	Event
January 18, 2022	Tuesday	First Day of Classes
January 22, 2022	Saturday	Saturday Classes Begin
January 24, 2022	Monday	Last Day to Add/Drop Classes
March 14, 2022	Monday	Spring Recess Begins
March 19, 2022	Saturday	Spring Recess Ends
April 4, 2022	Monday	Last Day to Withdraw
April 15, 2022	Friday	Good Friday - No Classes
April 17, 2022	Sunday	Easter Sunday - No Classes
May 3, 2022	Tuesday	Friday Classes Meet
May 3, 2022	Tuesday	Last Day of Classes
May 4 - May 5, 2022	Wednesday and Thursday	Reading Days
May 6 - May 12, 2022	Friday to Thursday	Final Exam Period

Course Outline

Tutors are available in accordance with the Math department's posted schedule.

Date	Lecture	Sections	Topic
1/19	1		Introduction to the Course, Class Dynamics, Guidelines for Success
1/21			Lab session 1: MATLAB basics; Series
1/24	2	0.1-0.5	Numerical Methods Foundations: Taylor Series, Error
1/26	3	1.1	Rootfinding for nonlinear equations – Bisection Method (IVT, MVT)
1/28			Lab session 2: Bisection
1/31	4	1.2	Rootfinding for nonlinear equations – Fixed Point Iteration
2/2	5	1.3	Rootfinding for nonlinear equations – Error considerations
2/4			Lab session 3: Fixed Point Iteration
2/7	6	1.4-1.5	Rootfinding for nonlinear equations – Newton's Method and Secant Method
2/9	7	3.1	Review for Exam 1 and Polynomial Interpolation
2/11			Lab session 4: Newton's Method and Secant Method
2/14	8		Exam 1
2/16	9	3.1	Polynomial Interpolation
2/18			Lab session 5: Lagrange Polynomials
2/21	10	3.2	Polynomial Interpolation Error
2/23	11	3.3	Chebyshev Polynomials
2/25			Lab session 6: Chebyshev Polynomials

2/28	12	3.3	More Chebyshev Polynomials
3/2	13	3.4	Cubic Splines
3/4			Lab session 7: Cubic Splines
3/7	14	5.1	Review for Exam 2 and Numerical Differentiation
3/9	15	5.1	Exam 2 and Numerical Differentiation
3/11			Lab session 8: Numerical Differentiation
3/21	16	5.2	Numerical Integration
3/23	17	5.3	Romberg Integration and Richardson Extrapolation
3/25			Lab session 9: Numerical Integration and Richardson Extrapolation
3/28	18	5.5	Gaussian Quadrature
3/30	19	6.1	Review for Exam 3 and Ordinary Differential Equations – Basics, Direction Fields
4/1			Lab session 10: Gaussian Quadrature
4/4	20	6.1-6.2	Exam 3 and Ordinary Differential Equations – Euler's Method and its Error Analysis
4/6	21	6.2	Ordinary Differential Equations – Taylor Series Methods
4/8			Lab session 11: Euler's Method
4/11	22	6.3	Ordinary Differential Equations – Systems of ODEs
4/13	23	6.4	Ordinary Differential Equations – Runge Kutta Methods
4/18	24	6.6	Ordinary Differential Equations – Stiff Equations, Stability and Implicit Methods
4/20	25	6.7	Ordinary Differential Equations – Multi-Step Methods and Stability
4/22			Lab session 12: Runge Kutta Methods
4/25	26	7.1	Review for Exam 4 and ODE-Boundary Value Problems – Shooting Method
4/27	27		Exam 4 and BVP Finite Differences
4/29		7.2	Lab session 13: Stability
5/2	28		Review for Final Exam and Miscellaneous Topics
5/3			Lab session 14: Make up or Independent project
5/6-5/12			FINAL EXAM WEEK

Updated by Professor B. Bukiet - 1/7/2022
Department of Mathematical Sciences Course Syllabus, Spring 2022