MATH 340: Applied Numerical Methods

Fall 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.

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 340-001	Professor B. Bukiet
Math 340-003	Professor B. Bukiet

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

Recommended Textbook:

Title	*Numerical Analysis*
Author	Timothy Sauer
Edition	3rd
Publisher	978-0134696454
ISBN #	Pearson

University-wide Withdrawal Date: The last day to withdraw with a **M** is **Monday, November 14, 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	TBA
Midterm Exam II	TBA
Midterm Exam III	TBA
Midterm Exam IV	TBA
Final Exam Period	December 16 – 22, 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: Fall 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.

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

Date	Day	Event

September 5, 2022	Monday	Labor Day
September 6, 2022	Tuesday	First Day of Classes
September 12, 2022	Monday	Last Day to Add/Drop Classes
November 14, 2022	Monday	Last Day to Withdraw
November 22, 2022	Tuesday	Thursday Classes Meet
November 23, 2022	Wednesday	Friday Classes Meet
November 24 to November 25, 2022	Thursday and Friday	Thanksgiving Recess - Closed
November 26, 2022	Saturday	Saturday Classes Meet
December 14, 2022	Wednesday	Last Day of Classes
December 15, 2022	Thursday	Reading Day
December 16 to December 22, 2022	Friday to Thursday	Final Exam Period

Course Outline

(Tentative)

Homework assignments REQUIRE use of MATLAB software.
Tutors are available in accordance with the Math department's posted schedule.

Date	Lecture	Sections	Topic
9/6	1		Introduction to the Course, Class Dynamics, Guidelines for Success
9/8	2	11.1	Bisection Method (prior knowledge IVT, MVT)
9/9	Lab 1		Lab session 1: MATLAB basics; Series
9/13	3	1.3, 1.5	Forward and Backward Error and Secant Method / Regula Falsi
9/15	4	1.4	Newton's Method and Error
9/16	Lab 2		Lab session 2: Bisection
9/20	5	1.2	Fixed Point Iteration: Fixed Point Error considerations (prior knowledge: Taylor Series)
9/22	6	notes	Higher order iteration and Accelerating convergence
9/23	Lab 3		Lab session 3: Newton
9/27 RH	Lab 4		Lab 4: Fixed Point Iteration
9/29	7	4.1-4.2	Review for Exam 1 and start Least Squares
9/30	8		Exam 1 during lab
10/4	9	4.1-4.2	Least Squares
10/6	10	3.1-3.2	Polynomial Interpolation; Lagrange Polynomials and error
10/7	Lab 5		Lab session 5: Least Squares
10/11 Sukkot	Lab 6		Lab session 6: Lagrange Polynomials
10/13	11	3.3	Chebyshev Polynomials
10/14	12	3.4	Cubic Splines
10/18 Shmini	Lab 7		Lab session 7: Cubic Splines
10/20	13	5.1	Numerical Differentiation
10/21	14		Review for Exam 2

10/25	15	5.1	Exam 2
10/27	16	5.2	Numerical Integration
10/28	Lab 8		Lab session 8: Numerical Differentiation
11/1	17	5.3	Romberg Integration and Richardson Extrapolation
1/3	18	5.5	Gaussian Quadrature
11/4	Lab 9		Lab session 9: Numerical Integration and Richardson Extrapolation
11/8	19	6.1	Ordinary Differential Equations: Euler's Method
11/10	Lab 10		Lab session 10: Gaussian Quadrature
11/11	20		Review for Exam 3
11/15	21		Exam 3
11/17	22	6.2	Ordinary Differential Equations – Taylor Series Methods
11/18	Lab 11		Lab session 11: Euler's Method
11/22	23	6.4	Ordinary Differential Equations – Runge Kutta Methods
11/23	Lab 12		Lab session 12: Runge Kutta Methods
11/29	24	6.4	Ordinary Differential Equations – Systems of ODEs
12/1	25	6.6-6.7	Ordinary Differential Equations – Implicit Methods, Multi-Step Methods and Stability
12/2	Lab 13		Lab session 13: Systems or Multistep methods
12/6	26		Review for Exam 4 and Miscellaneous Topics
12/8	27		Exam 4
12/9	Lab 14		Lab session 14: Makeup or Extra Credit Lab
12/3	28		Review for Final Exam and Miscellaneous Topics
12/16-12/22			FINAL EXAM WEEK
	*		Order of sessions may be adjusted that week due to calendar issues

Updated by Professor B. Bukiet - 8/11/2022
Department of Mathematical Sciences Course Syllabus, Fall 2022