**Department of Mathematics & Statistics**
**Concordia University**

# MATH 354 (MAST 334)

Numerical Analysis

***Fall 2019***

Instructor*: _____

Office/Tel No: _____

Office Hours: _____

*Students should get the above information from their instructor during class time. The instructor is the person to contact should there be any questions about the course.

**Objectives:** Numerical analysis deals with the approximate numerical solutions of the problem whose exact solution is either impossible or unreasonably complicated. Thus, numerical analysis is an interface between the theoretical mathematics and its innumerable applications. In this course the students will learn how to solve the basic numerical problems using advanced analytical tools, and the use of powerful computational systems for the actual computations. Theoretical aspects such as error analysis, best approximation, methods providing solutions with better convergence and less computational complexity will be considered.

**Text:** ***Numerical Analysis***, by R. Burden and D. Faires, 9th Edition, Brooks/Cole, Engage Learning, 2011. Copy of the textbook is reserved for the course in Concordia Webster Library, LB Building.

**Assignments:** Assignments are very important as they indicate the level of difficulty of the problems that students are expected to solve and understand them independently. Students are encouraged to use Maple or other software of such kind during assignments. Students are expected to submit assignments weekly. **Late assignments will not be accepted.** Some questions (but not all) will be marked. Solutions to the assignment problems will be posted on the Moodle.

**Mid-Term Test:** There will be one mid-term test in week 8. **PLEASE NOTE:** It is the Department's policy that tests missed for any reason, including illness, cannot be made up. If you miss a test, the Final Exam will count for 90% of your final grade.

**Final Examination:** At the end of course, there will be a 3-hour closed book final examination. **PLEASE NOTE:** Students are responsible for finding out the date and time of the final exam once the schedule is posted by the Examination Office. Any conflicts or problems with the scheduling of the final exam must be reported directly to the Examination Office, **not** to your instructor. It is the Department's policy and the Examination Office's policy **that students are to be available until the end of the final exam period. Conflicts due to travel plans will not be accommodated.**

**Final Grade:** The highest of the following: (20% assignments + 20% midterm test + 60% final exam) or (10% assignments + 90% final exam).

If the grading scheme for this course includes graded assignments, a reasonable and representative subset of each assignment may be graded. Students will not be told in advance which subset of the assigned problems will be marked and should therefore attempt all assigned problems.

**Calculators:** Only calculators approved by the Department (with a sticker attached as proof of approval) are permitted in the class test and final examination. The preferred calculators are the **Sharp EL531** and **Casio FX 300MS**, available at the Concordia Bookstore.

**Plagiarism:** Cases of plagiarism (including the assignments, the midterm test and the final exam) will be treated according to the University policy.

| Week | Section | Topics | Pages | Assignments |
|---|---|---|---|---|
| 1 | 1.1<br>1.2<br>1.3 | Review of Calculus<br>Round-off Errors and Computer Arithmetic<br>Algorithms and Convergence | p.14<br>p. 28<br>p.39 | 2(b), 3(c), 13<br>5(c,d,h), 12, 13(a),21<br>7(d),15 |
| 2 | 2.1<br>2.2 | The Bisection Method<br>Fixed-point method | p.54<br>p.64 | 8, 12, 15, 19<br>4, 8, 9, 12(d), 20 |
| 3 | 2.3 | Newton's Method and Its Extensions – Newton-Raphson and Chebyshev Fixed Point Methods | p.75 | 6(b), 8(b), 10(b), 18, 25, 32 |
| 4 | 2.4<br>2.5<br>2.6 | Error Analysis for Iterative Methods<br>Accelerating Convergence – Aitken's method, Steffenson's method<br>Zeros of Polynomials, Horner's Method | p.85<br>p.90<br>p.100 | 2(a), 4(a), 7, 10<br>12(b),15<br>2(g) |
| 5 | 3.1<br>3.2 | Interpolation and Lagrange Polynomial<br>Data Approximation and Neville's Method | p.114<br>p.123 | 2(d), 4(d), 9, 13(d), 17, 18(a)<br>3, 4, 6, 8, 10 |
| 6 | 3.3<br>3.4 | Divided Differences<br>Hermite Interpolation | p.133<br>p.142 | 8, 9, 12, 16, 17, 15, 19<br>9, 10, 12 |

| | | | | |
|---|---|---|---|---|
| 7 | 3.5 | Cubic Spline interpolation.<br>**Review** | p.161 | 4(c), (c), 8(c), 12, 13, 19, 28 |
| 8 | 8.1 | **Class Test (weeks 1 – 5)**<br>Discrete Least Squares Approximation | p.506 | 5, 14 |
| 9 | 8.2 | Orthogonal Polynomials and Least Squares Approximation | p.518 | 2(e), 4(e), 6(e), 7(c), 11, 14 |
| 10 | 8.3 | Chebyshev Polynomials and Economization of Power Series | p.527 | 2(b), 4(b), 5(d), 7, 8, 11 |
| 11 | 4.1<br>4.2 | Numerical Differentiation<br>Richardson's Extrapolation | p.182<br>p.191 | 2(b), 4(b), 6(a), 20, 28<br>1(c), 2(c), 6, 9 |
| 12 | 4.3<br>4.4 | Elements of Numerical Integration<br>Composite Numerical Integration | p.202<br>p.210 | 1(g), 3(g), 9(g), 11(g), 15,18<br>11(a,c) |
| 13 | 4.7 | Gaussian Quadrature Formulas<br>**Review** | p.234 | 1(f), 2(f), 6, 8 |

**Academic Integrity and the Academic Code of Conduct**

This course is governed by Concordia University's policies on Academic Integrity and the Academic Code of Conduct as set forth in the Undergraduate Calendar and the Graduate Calendar. Students are expected to familiarize themselves with these policies and conduct themselves accordingly. "Concordia University has several resources available to students to better understand and uphold academic integrity. Concordia's website on academic integrity can be found at the following address, which also includes links to each Faculty and the School of Graduate Studies: concordia.ca/students/academic-integrity." *[Undergraduate Calendar, Sec 17.10.2]*