MA 214: Introduction to numerical analysis (2021–2022)

Text/References:

- S. D. Conte and Carl de Boor, *Elementary Numerical Analysis: An Algorithmic Approach* (3rd Edition), McGraw Hill, 1980.

- K. Atkinson and W. Han, *Elementary Numerical Analysis* (3rd Edition), Wiley-India, 2004.

Course Plan:

The following is a rough plan of the course. The video lectures are/will be available on YouTube at the link:

`https://tinyurl.com/MA214-SMG`.

(1) **Machine arithmetic:** Introduction, floating point arithmetic. (3 lectures)

(2) **Equations in one variable:** Bisection method, Newton-Raphson method, Secant method and their variations. (6 lectures)

(3) **Interpolation:** Interpolation by polynomials; Neville's method, divided differences; piece-wise linear, cubic Hermite and cubic Spline interpolation. (7 lectures)

(4) **Numerical differentiation and integration:** Richardson's extrapolation, trapezoidal and Simpson's rules, romberg integration, Gaußian quadrature. (8 lectures)

(5) **Ordinary differential equations:** Initial value problem for ordinary differential equations, Euler's method, Runge-Kutta methods, multi-step methods, stability issues. (8 lectures)

(6) **Linear algebra:** Pivoting, Gauß elimination, LU-decomposition, Cholesky decomposition, matrix norms, Jacobi and Gauß-Seidel methods. (8 lectures)

(7) **Least squares approximation:** Orthogonal and Chebyshev polynomials, trigonometric polynomial approximation. (4 lectures)

(8) **Approximating eigenvalues:** Gerschgorin theorem, power & inverse power methods, QR-method. (12 lectures)

Tutorials: There will be a tutorial session each Wednesday, as per the schedule decided by your TA. Each student is assigned a tutorial batch and has been provided with the code for joining the corresponding Google classroom. All the information related to this course will be shared in these classrooms.

On the Wednesdays following an examination, mid-sem or the quizzes, there will be a discussion on the examination.

On the remaining 10 Wednesdays, various problems based on the lecture videos will be discussed.

Evaluation Plan:

- The Mid-Semester Examination, scheduled to be held during 19-26 February, will be of 30% weightage and the End-Semester Examination, scheduled to be held during 18-30 April, will be of 50% weightage.

- In addition, there will be two quizzes, on 28 January and 25 March, of 10% weightage each. The quizzes will be held in the morning from 8.15 am till 9.15 am.

- The syllabus for each examination will be as follows:

  - Quiz 1: lectures 1–16,
  - Mid-sem: lectures 1–28,
  - Quiz 2: lectures 29–44,
  - End-sem: all lectures.

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