# Banach Algebras
# MATH 5003 – MAT 5122
## Fall 2020

- **Instructor:**
  Prof. Matthias Neufang
  School of Mathematics and Statistics
  Herzberg Laboratories, Office: 4332 HP
  Email: *mneufang@math.carleton.ca*
  Phone: (613) 520 2600 ext. 4274
  Fax: (613) 520 3536
  Webpage: `https://carleton.ca/math/people/matthias-neufang`
- **Office hours:** Monday, 11 a.m. – 1 p.m., on cuLearn (via BigBlueButton)
- **Prerequisites:** Permission of the School.
- **Material:** Matthias Neufang and Volker Runde, *Banach Algebras and Abstract Harmonic Analysis – A Contemporary Approach*, Pre-monograph, 2020.
- **Additional reading (NOT required):**
  - Frank F. Bonsall and John Duncan, *Complete Normed Algebras*, Ergebnisse der Mathematik und ihrer Grenzgebiete, 80, Springer-Verlag, New York–Heidelberg, 1973.
  - John B. Conway, *A Course in Functional Analysis*, Second Edition, Graduate Texts in Mathematics, 96, Springer-Verlag, New York, 1990.
  - H. Garth Dales, *Banach Algebras and Automatic Continuity*, London Mathematical Society Monographs, New Series, 24, Oxford Science Publications, The Clarendon Press, Oxford University Press, New York, 2000.
  - H. Garth Dales, Pietro Aiena, Jörg Eschmeier, Kjeld Laursen and George Willis, *Introduction to Banach Algebras, Operators, and Harmonic Analysis*, London Mathematical Society Student Texts, 57, Cambridge University Press, Cambridge, 2003.
  - Gerard J. Murphy, *$C^*$-Algebras and Operator Theory*, Academic Press, Inc., Boston, MA, 1990.
  - Theodore W. Palmer, *Banach Algebras and the General Theory of $^*$-Algebras, Volume I: Algebras and Banach Algebras*, Encyclopedia of Mathematics and its Applications, 49, Cambridge University Press, Cambridge, 1994.
  - Theodore W. Palmer, *Banach Algebras and the General Theory of $^*$-Algebras, Volume II: $^*$-Algebras*, Encyclopedia of Mathematics and its Applications, 79, Cambridge University Press, Cambridge, 2001.
  - Gert K. Pedersen, *Analysis Now*, Graduate Texts in Mathematics, 118, Springer-Verlag, New York, 1989.

- **Lectures:** Tuesday and Thursday, 1:05–2:25 p.m., posted on cuLearn (asynchronous learning modality)
- **Beginning** of classes: Thursday, September 10, 2020.
  **End** of classes: Thursday, December 10, 2020.
- **Evaluation:** The mark is determined by four graded assignments (25% each). There is no final exam or midterm exam.
- **Withdrawal:** Last day for withdrawal from the course (with full fee adjustment): Wednesday, September 30, 2020.
- **Students with disabilities** who require academic accommodations in this course are encouraged to contact a coordinator at the **Paul Menton Centre** (501 University Centre) – email: PMC@carleton.ca, phone: 613 520 6608 – to complete the required forms. After registering with the PMC, discuss your needs with me as early as possible.

## Course Outline

**Brief description (as per the Graduate Calendar):** Commutative Banach algebras; the space of maximal ideals; representation of Banach algebras as function algebras and as operator algebras; the spectrum of an element. Special types of Banach algebras: for example, regular algebras with involution, applications.

The course gives a friendly introduction to the area of Banach algebras, and operator algebras ($C^*$- and von Neumann algebras). The theory has applications to numerous mathematical fields, ranging from harmonic analysis and representation theory to operator spaces and quantum information theory.

The following shows the topics to be covered in the course:

1. The spectrum and the Gelfand transform
2. Bounded approximate identities and factorization
3. Biduals of Banach algebras
4. Elements of the theory of operator algebras