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THE CHINESE UNIVERSITY OF HONG KONG
Department of Mathematics
MATH1050A (First term, 2019-20)
Foundation of Modern Mathematics

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This course introduces rigorous mathematical reasoning, proofs, and high dimensional geometry. The use of logic in mathematics and various methods of proof will be illustrated by concrete examples from a variety of topics in mathematics.

Topics are selected amongst: logic and axiomatic systems; sets, relations and functions; infinite sets and countability; numbers and polynomials; lines, planes, conics and quadrics.

Instructor

- Fong Wing-Chung (Office: Rm 218 LSB. Email: `wcfong@math.cuhk.edu.hk`)

Tutors

- Ng Ming Ho (Office: Rm 228 LSB. Email: `mhng@math.cuhk.edu.hk`)

- Feng Zhou (Office: Rm 232 LSB. Email: `zfeng@math.cuhk.edu.hk`)

Time and Venue

- Lectures-and-tutorials: Mondays and Wednesdays 1430-1615hrs LSB LT5.

- Supplementary lecture:

    * Time: 1930-2115hrs, Wednesday 9/10. Venue: LSB C5.
    * Time: 1930-2115hrs, Wednesday 6/11. Venue: LSB C5.

Tutor's consultation hours

- Ng Ming Ho: Mondays 1030-1130hrs, Wednesdays 1030-1130hrs.

- Feng Zhou: Tuesdays 1500-1700hrs.

Course Material and Course Announcements

Course material (for example, supplementary notes, assignments, tutorial sheets) will be uploaded to the course homepage at

`http://www.math.cuhk.edu.hk/course_builder/1920/math1050a/1050ahp-mat.html`

Course announcements made in class may be put onto the course homepage and communicated via the CWEM.

Teaching Schedule

The schedule is provisional. We will adapt it along the way to suit the mathematical capability of the students.

- Weeks 1-6: various methods of mathematical proofs; set operations; logic; numbers.

- Weeks 7-11: functions and relations.

- Weeks 12-13: infinite sets.

(Revised) Assessment Scheme

* **Assignments**:

  You will be awarded one mark for satisfactory performance in your submitted mandatory work of each assignment.

* **Quiz**:

  There is one quiz.

  Date: 31/10 (in Week 9). Time: 1900-2100hrs. Venue: LSB LT1.

Your overall score C in the course will be given by

$$C = \min\{20, 3.5A\} + \frac{Q}{100}\left(100 - \min\{20, 3.5A\}\right).$$

Here A is your total assignment score, and Q is your quiz score out of the full score of 100.

Assignments, and Supplements to Assignments

* Each **assignment** may contain questions of various types and of various difficulty levels.

  * **Mandatory work.** In each assignment, you will be instructed on which questions you are required to submit your work. They are usually straightforward questions.

    Your submitted mandatory work counts in overall assessment.

  * **Optional work.** In some assignments, you may be given the option of submitting your work on some simple proof-type questions. It is intended for training in the writing of proofs.

    The optional work does not count in the overall assessment.

  * Questions in an assignment which are neither 'mandatory' nor 'optional' are meant to be material for self-study and/or review. More of such questions will be listed in the supplement to the corresponding assignment.

* When you write up your work for an assignment, please remember these points:

  1. Use A4-size sheets, preferrably white, or with a background colour which is as light as possible.

  2. Leave sufficient space on the sheets, especially for optional work, so that feedback to your work can be written on the sheets.

  3. The mandatory work and the optional work may be read by different persons. So submit them separately.

  You are also expected to observe the policy of the CUHK on honesty in academic work very carefully. Detail may be found at

  https://www.cuhk.edu.hk/policy/academichonesty/

* Questions which require more thought and/or work and/or tricks and/or organization and/or ... are marked by $\diamondsuit, \clubsuit, \heartsuit, \spadesuit$, in ascending order of overall difficulty level.

* **Answers** will be provided. If you want to know whether your solution to any particular problem is correct, you must contact the tutors, preferrably during the **tutors' consultation hours** (or any time they agree to meet you).

Miscellaneous Learning Support

- **TA Consultation Sessions.**

  More detail (including *time* and *venue*) will be announced in due course.

- **Mathgym**.

  This provides one-to-one consultation service on maths problems.

Books and other learning resources

- **'Survival guide' on undergraduate studies in mathematics**.

  The book below offers valuable general advice on how to get used to abstract and 'proof-type' mathematics courses:

  * L. Alcock, *How to Study for a Mathematics Degree*, Oxford University Press.

  Also refer to the academic advice offered by the department:

  http://www.math.cuhk.edu.hk/student-centre/academic-advice

- **Transition to abstract mathematics and proofs**.

  These books below (and many others) cover to various extent much (but not necessarily all) of the course material, with a special emphasis on doing mathematical proofs, and may serve as general reference.

  1. B. Bajnok, *An Invitation to Abstract Mathematics*, Springer-Verlag.
  2. M. Beck, R. Geoghegan, *The Art of Proof: basic training for deeper mathematics*, Springer-Verlag.
  3. K. G. Binmore, *Foundations of Analysis: a straightforward introduction (Book 1 Logic, Sets and Numbers)*, Cambridge University Press.
  4. E. D. Bloch, *Proofs and Fundamentals: a first course in abstract mathematics*, (First or Second Edition), Birkhäuser/Springer-Verlag.
  5. D. W. Cunningham, *A Logical Introduction to Proof*, Springer-Verlag.
  6. U. Daepp, P. Gorkin, *Reading, Writing, and Proving: a closer look at mathematics* (Second Edition), Springer-Verlag.
  7. L. J. Gerstein, *Introduction to Mathematical Structures and Proofs* (Second Edition), Springer-Verlag.
  8. K. T. Leung, P. H. Cheung, *Fundamental Concepts of Mathematics*, Hong Kong University Press.
  9. I. Stewart, D. Tall, *Foundation of Mathematics* (Second Edition), Oxford University Press.

  Most of them are available in electronic version from the University Library.

- **Set theory**.

  For a deeper discussion on set language (and set theory), you may consult these books:

  1. P. R. Halmos, *Naïve Set Theory*, Springer-Verlag.
  2. K. T. Leung, D. L. C. Chan, *Elementary Set Theory*, Hong Kong University Press.

3. C. Schumacher, *Chapter Zero* (Second Edition), Addison-Wesley.

- **Overview in mathematics**.

  To put the material in this course in the context of the rest of mathematics, you may refer to these books:

  1. R. Courant, H. Robbins, I. Stewart, *What is mathematics: an elementary approach to ideas and methods* (Second Edition), Oxford University Press.

  2. H. Eves, *Foundations and Fundamental Concepts of Mathematics* (Third Edition), Dover.

  3. I. Stewart, *Concepts of Modern Mathematics*, Dover.

- **Basic/school mathematics**.

  These books provide reference to basic/school mathematics (a.k.a. 'old-curriculum' *additional mathematics* and *pure mathematics*) that a MATH/BMED/MIEG students should be well-versed.

  1. B. D. Bunday, H. Mulholland, *Pure Mathematics for Advanced Level*, Butterworths 1970.
     (This is available at `https://archive.org/`.)

  2. R. I. Porter, *Further Mathematics*, Bell and Hyman Limited 1970.
     (This is available at `https://archive.org/`.)

  3. C. J. Tranter, *Adavnced Level Pure Mathematics*, (any edition)
     (This is available at `https://archive.org/`.)

  4. S. L. Green, *Advanced Level Pure Mathematics*, (any edition).

Any textbook for HKCEE Mathematics, HKCEE Additional Mathematics, HKHLE General Mathematics, HKHLE Higher Mathematics, HKALE Pure Mathematics, can serve as a reference in this area. The older ones are usually the better ones in terms of depth. The more recent ones usually contain more (worked) examples. Many such books can be found in the 'school textbook' collection in the Chung-Chi Library.