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THE CHINESE UNIVERSITY OF HONG KONG
Department of Mathematics
MATH1050A (First term, 2018-19)
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

- Cheung Hang (Office: Rm 222A LSB. Email: `hcheung@math.cuhk.edu.hk`)

- Yao Huadong (Office: Rm 222A LSB. Email: `hdyao@math.cuhk.edu.hk`)

Time and Venue

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

- Supplementary lecture:

  * Time: 1830-2015hrs, Monday 12/11. Venue: *To be announced.*

Tutor's consultation hours

- Cheung Hang: Mondays 1230-1330hrs, Wednesdays 1730-1930hrs, Thursdays 1430-1530hrs.

- Yao Huadong: Mondays 1030-1230hrs, Wednesdays 1030-1230hrs.

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/1819/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.

Assessment Scheme

- **Coursework**: 50%

  - **Assignments**:
    Each assignment contains two parts (Parts 1, 2).
    You will be awarded one mark for satisfactory performance in Part 1 of each assignment.

  - **Quiz**:
    There is one quiz.
    Date: 1/11 (in Week 9). Time: 1900-2100hrs. Venue: *To be announced.*

  Your coursework score C will be given by the formula

  $$C = \min\left\{\frac{5A}{4}, 10\right\} + \left[\frac{9A}{10} + \frac{Q}{100}\left(40 - \frac{9A}{10}\right)\right].$$

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

- **Final Examination**: 50 %
  The examination papers are the same for both sections.

- Your grade will be determined by your overall performance in the various assessment components of the course, regardless of which section you have registered in.

Assignments

- Each **assignment** contains two parts (Parts 1, 2).

  - **Part 1** is usually made up of straightforward questions.
    Work in **Part 1** counts in overall assessment.
  - **Part 2** is usually made up of simple proof-type questions. It is intended for training in the writing of proofs.
    Work in **Part 2** does not count in overall assessment.

- Your work for Part 1, Part 2 must be submitted 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.

How to submit your work on Part 2 of Assignments

Although Part 2 does not count in the overall assessment, you are encouraged to submit your work for Part . We suggest you proceed as described below:

1. Write up your work on A4-size sheets, preferrably white, or with a background colour which is as light as possible.

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

3. Meet either TA before submitting your work for Part 2. You will be told where you should improve your work.

4. Take the TA's advice seriously, and re-write your work. Then submit your work.

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, Additional Mathematics, and any textbook for 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 accessible examples.