MATH4404 Functional Analysis

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1 Timetable

- Lectures: ﬃﬃﬃﬃﬃﬃ ﬃﬃﬃﬃﬃﬃﬃ - ﬃﬃﬃﬃﬃﬃ, room ﬃﬃﬃﬃﬃﬃ.
- Structure is a Reading Course with Weekly Assignments.
- Consultation: Toﬃbeﬃannouncedy ﬃﬃﬃ - ﬃﬃﬃ, in my office.

2 Prerequisites and incompatibles

Prerequisites: MATH 3402 Functional Analysis or MP303 or MP386.

Incompatibles: MP387 or MP489.

3 Assessment

Assignments: There will be 10 homework assignments, each worth 10% of the grade.

Final: This is the full assessment procedure.

4 Purpose

This subject considers analysis of normed spaces and linear maps between normed spaces.

5 Subject outline

We will try to cover as much of the listed topics as time permits.

1. Review of basic topological concepts and some basic facts about metric spaces.
2. Banach spaces: linear operators and functionals; uniform boundedness principle; Hahn-Banach, closed graph and open mapping theorems.
3. Dual spaces, weak and strong convergence; adjoints.
4. Hilbert spaces: orthogonality; projections; Riesz representation theorem.
5. Riesz-Schauder Theory of Compact Linear Operators.
6. Fredholm Alternative.

6 Textbooks

There is no required textbook. The following is a list of some textbooks on Functional Analysis which I recommend. I supply the library code in the brackets. I list also some textbooks covering the background material.

1. Walter Rudin, *Functional Analysis*, 2nd ed., McGraw-Hill, New York, 1991. (QA320.R83 1973)
2. George F. Simmons, *Topology and Modern Analysis*, McGraw-Hill, New York, 1963. (QA611.S49 1983)
3. Kosaku Yosida, *Functional Analysis*, 2nd ed., Springer-Verlag, New York, 1968. (QA320.Y6 1965)
4. Nelson Dunford and Jacob T. Schwarz, with the assistance of William G. Bade and Robert G. Bartle, *Linear Operators*, Interscience, New York, 1958. (QA251.D8 1958)
5. Walter Rudin, *Real and Complex Analysis*, 2nd ed., McGraw-Hill, New York, 1974. (QA300.R82 1987)
6. H. L. Royden, *Real Analysis*, 2nd ed., MacMillan, New York, 1968. (QA331.5.R6 1968) (The 3rd ed. appeared in 1988, but it is not in the library.)
7. James R. Munkres, *Topology*, 2nd ed., Prentice Hall, Inc., Upper Saddle River, c2000. (QA611.M82 2000)

7 Assessment criteria

Solutions will be marked for accuracy, appropriateness of mathematical techniques and clarity of presentation, as demonstrated by examples presented in lectures.

Your grade for this subject will be determined by the highest of the following levels of achievement that you consistently display in the items of summative assessment.

- Grade of 7: the student demonstrates an excellent understanding of the theory of the topics listed in the course outline and is highly proficient in applying the techniques to solve both theoretical and practical problems.
- Grade of 6: the student demonstrates a comprehensive understanding of the theory of the topics listed in the course outline and is proficient in applying the techniques to solve both theoretical and practical problems.
- Grade of 5: the student demonstrates an adequate understanding of the theory of the topics listed in the course outline and can apply the techniques to solve problems.
- Grade of 4: the student demonstrates an understanding of the theory of the topics listed in the course outline and demonstrates knowledge of the techniques used to solve problems.
- Grade of 3: the student demonstrates some understanding of the theory of the topics listed in the course outline and demonstrates knowledge of the techniques used to solve problems.
- Grade of 2: the student demonstrates limited understanding of the theory of the topics listed in the course outline and demonstrates limited knowledge of the techniques used to solve problems.
- Grade of 1: the student demonstrates very limited understanding of the theory of the topics listed in the course outline and demonstrates very limited knowledge of the techniques used to solve problems.