**Brief description of course content:**
The course is intended as a straightforward treatment of the parts of measure theory and the Lebesgue integral necessary for analysis, probability, functional analysis, mathematical physics, financial calculus and many branches of applied sciences. The Lebesgue integral is a basic tool in a modern approach to nonlinear analysis. Lectures cover the construction of the Lebesgue measure, the Lebesgue integral their basic properties (limits theorems) and some discussion of the Lebesgue spaces of integrable functions.

**Staff (Course Coordinator) : Dr Jan Chabrowski**

**Lecturers and Contact Details**

Name: Dr Jan Chabrowski  
Room number: 347, Priestley Building (67)  
Phone number: 33653259  
Email: jhc@maths.uq.edu.au  
Consultation hours or Office hours: Monday 9—10, Tuesday 9—10

**Tutorial Coordinator: Dr Jan Chabrowski**

The course profile and course material can be found on the web at the following address: http://www.maths.uq.edu.au/course/MATH4405. This also contains up-to-date news about the course material and announcements for students. Please check this regularly during the semester.

**Class contact hours:**  3L, 1T

The lectures are scheduled for:

Monday 10.00 Room 67 – 341  
Tuesday 2.00 Room 67 - 341  
Thursday 9.00 Room 67 - 342  
Tutorial classes will be held Thursday 3.00 in room 67 – 341

**Assumed background:** familiarity with mathematical analysis (MATH2400)  
And basic knowledge of a set theory. It is a student’s own responsibility to fill in any gaps in their assumed knowledge.
Course goals/rationale

On completing this course students will:

- Obtain a sound knowledge of the measure theory and the Lebesgue integral.
- Be able to undertake studies in many branches of the modern mathematics like: non-linear analysis, non-linear partial differential equations, variational calculus, stochastic processes and mathematical physics.
  - Be able to pursue further studies in applied sciences requiring the knowledge of the theory of Lebesgue integral like control and optimisation theory.

Graduate Attributes

The following graduate attributes will be developed in the course –

In-Depth Knowledge of the Field of Study

- A comprehensive and well-founded knowledge of the field of study.
- An understanding of how other disciplines relate to the field of study.
- An international perspective on the field of study.

Effective Communication

- The ability to collect, analyse, and organise information and ideas, and to convey those ideas clearly and fluently, in both written and spoken forms.
  - The ability to interact effectively with others in order to work towards a common outcome.
  - The ability to select and use the appropriate level, style and means of communication.
  - The ability to engage effectively and appropriately with information and communication technologies.

Independence and Creativity

- The ability to work and learn independently.
- The ability to generate ideas and adapt innovatively to changing environments.
- The ability to identify problems, create solutions, innovate and improve current practices.

Critical Judgement

- The ability to define and analyse problems
- The ability to apply critical reasoning to issues through independent thought and
informed judgement
- The ability to evaluate opinions, make decisions and to reflect critically on the justifications for decisions.

**Ethical And Social Understanding**

- An understanding of social and civic responsibility
- An appreciation of the philosophical and social contexts of a discipline
- A knowledge and respect of ethics and ethical standards in relation to a major area of study
- A knowledge of other cultures and times and an appreciation of cultural diversity.


**Teaching and Learning Methods**

Three hours of lectures and one hour of tutorials per week.

There are no tutorials in week 1 and week 13. An extra tutorial in week 13 can be held by special arrangement with the lecturer.

Students should attend all lectures and tutorials. Since parts of this course are based on abstract constructions, it is necessary to study lecture notes from previous lectures prior to attending each subsequent lecture. By following this procedure, you will find this course both enjoyable and informative.

Tutorial sheets will be handed out in lectures each week. Solutions to the tutorial problems will be available in the following week at tutorials. You should aim to do as many problems as possible on the tutorial sheet before the tutorial and ask about anything you do not understand at the tutorial and lecture.

**ASSESSMENT**

**Required assessment tasks:**

The assessment for this course will be based on a mid semester exam and an end of semester examination. **The mid semester exam is worth 35 marks and the final exam 65 marks. The mid semester exam will be held in week 7 during lecture time. The actual date will be announced on the web and in lectures as soon as possible.**

The mid semester exam will be based on the material covered in the first 6 weeks.

The final two hours examination will cover the material from the entire semester.
Any pocket calculators are permitted but contents of memory must be erased.
Grades will be awarded according to the following scale:

<table>
<thead>
<tr>
<th>Marks Range</th>
<th>Grade</th>
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<tbody>
<tr>
<td>1 - 19</td>
<td>1</td>
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<tr>
<td>20 - 44</td>
<td>2</td>
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<tr>
<td>45 - 49</td>
<td>3</td>
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<td>50 - 64</td>
<td>4</td>
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<td>65 - 74</td>
<td>5</td>
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<td>75 - 84</td>
<td>6</td>
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<td>85 - 100</td>
<td>7</td>
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</tbody>
</table>

Assessment criteria

Answers to written examination questions for both mid semester and final examinations will be assessed in terms of the extent to which they demonstrate the ability of the student to:

- Define, explain and interrelate main concepts involved in the course.
- Present proofs of the key theorems developed in the course.
- Apply the theory to solve some practical problems.
- Relate the measure theory to some concepts of the integral and differential calculus.

Criteria for the award of grades

To earn a Grade of 7, a student must demonstrate an excellent understanding of the course material. This includes clear expression of nearly all their deductions and explanations, the use of appropriate and efficient mathematical techniques and accurate answers to nearly all questions and tasks with appropriate justification. They will be able to apply mathematical techniques to completely solve both theoretical and practical problems.

To earn a Grade of 6, a student must demonstrate a comprehensive understanding of the course material. This includes clear expression of most of their deductions and explanations, the general use of appropriate and efficient mathematical techniques and accurate answers to most questions and tasks with appropriate justification. They will be able to apply mathematical techniques to partially solve both theoretical and practical problems.

To earn a Grade of 5, a student must demonstrate an adequate understanding of the course material. This includes clear expression of some of their deductions and explanations, the use of appropriate and efficient mathematical techniques in some situations and accurate answers to some questions and tasks with appropriate justification. They will be able to apply mathematical techniques to solve fundamental problems.

To earn a Grade of 4, a student must demonstrate an understanding of the basic concepts in the course material. This includes occasionally expressing their deductions and explanations clearly, the occasional use of appropriate and efficient mathematical techniques and accurate answers to a few questions and tasks with appropriate justification. They will have demonstrated knowledge of techniques used to solve problems and applied this knowledge in some cases.
To earn a Grade of 3, a student must demonstrate some knowledge of the basic concepts in the course material. This includes occasional expression of their deductions and explanations, the use of a few appropriate and efficient mathematical techniques and attempts to answer a few questions and tasks accurately and with appropriate justification. They will have demonstrated knowledge of techniques used to solve problems.

To earn a Grade of 2, a student must demonstrate some knowledge of the basic concepts in the course material. This includes attempts at expressing their deductions and explanations and attempts to answer a few questions accurately.

A student will earn a Grade of 1 if they show a poor knowledge of the basic concepts in the course material. This includes attempts at answering some questions but showing an extremely poor understanding of the key concepts.

**Assessment policy**

Students who miss the mid semester exam through bereavement or ill health should document their problems and discuss this with the lecturer of the course. An alternative assessment scheme may be negotiated between student and lecturer of the course.

Allowance cannot be made for reasons such as sporting or social commitments, or overwork in other courses.

Students should be familiar with the rules which relate to assessment in their degrees as well as general university policy such as found in the General Award Rules. These are all set out on the myAdvisor page on the UQ website http://www.uq.edu.au/student/GeneralRules2003/2003GARs.htm.

**Plagiarism:**

Below is the University’s definition of plagiarism:

Plagiarism is the action or practice of taking and using as one’s own the thoughts or writings of another (without acknowledgement). The following practices constitute acts of plagiarism and are a major infringement of the University’s academic values:

(a) where paragraphs, sentences, a single sentence or significant part of a sentence which are copied directly, are not enclosed in quotation marks and appropriately footnoted;

(b) where direct quotations are not used, but are paraphrased or summarised, and the source of the material is not acknowledged either by footnoting or other simple reference within the text of the paper;

(c) where an idea which appears elsewhere in print, film or electronic medium is used or developed without reference being made to the author or the source of that idea.
When a student knowingly plagiarises someone’s work, there is intent to gain an advantage and this may constitute misconduct.

Students are encouraged to study together and to discuss ideas, but this should not result in students handing in the same or similar assessment work. Do not allow another student to copy your work. While students may discuss approaches to tackling a tutorial problem, care must be taken to submit individual and different answers to the problem. Submitting the same or largely similar answers to an assignment or tutorial problem may constitute misconduct.

For more information on the University policy on plagiarism, please refer to http://www.uq.edu.au/hupp/contents/view.asp?s1=3&s2=40&s3=12

**Supplementary examinations**

A supplementary examination may be awarded in one course to students who obtain a grade of 2 or 3 in the final semester of their program and require this course to finish their degree. You should check the rules for your degree program for information on the possible award of supplementary examinations. Applications for supplementary examinations must be made to the Director of Studies in the Faculty.

EPSA Faculty policy on the award of supplementary exams may be found via the Faculty Guidelines from the EPSA student page http://www.epsa.uq.edu.au/index.html?id=9329&pid=7564

**Special examinations**

If a student is unable to sit a scheduled examination for medical or other adverse reasons, she/he can and should apply for a special examination. Applications made on medical grounds should be accompanied by a medical certificate; those on other grounds must be supported by a personal declaration stating the facts on which the application relies.

Applications for special examinations for central and end-of-semester exams must be made through the Student Centre. Applications for special examinations in school exams are made to the course coordinator.

More information on the University’s assessment policy may be found http://www.uq.edu.au/hupp/contents/view.asp?s1=3&s2=30&s3=5

EPSA Faculty policy on the award of special exams may be found via the Faculty Guidelines from the EPSA student page http://www.epsa.uq.edu.au/index.html?id=9329&pid=7564
Feedback on assessment:

You may request feedback on assessment in this course progressively throughout the semester from the course coordinator. Feedback on assessment may include discussion, written comments on work, model answers, lists of common mistakes and the like.

Students may peruse examinations scripts and obtain feedback on performance in a final examination provided that the request is made within six months of the release of final course results. After a period of six months following the release of results, examination scripts may be destroyed.

Information on the University’s policy on access to feedback on assessment may be found at http://www.uq.edu.au/hupp/contents/view.asp?s1=3&s2=30&s3=5

EPSA Faculty policy on assessment feedback and re-marking may be found at http://www.epsa.uq.edu.au/index.html?id=7674&pid=7564
Textbook and references:

All lectures are based on “Measure theory”, By Donal L. Cohn, Birkhauser, 1980.

- Students may also consult “Measure theory” by P. Halmos, Princeton: Van Nostrand 1950 (republished by Springer in 1974)
- The measure theory still attracts attention of many researchers. The following articles published by The American Mathematical Monthly are recommended as an additional reading:
  - The Am. Math. Monthly is available in PSE library.

Library contact:

The liaison librarian for the physical sciences disciplines is located in the Physical Sciences and Engineering Library in the Hawken Building and may be consulted for assistance in the course:

Leith Woodall
Email: l.woodall@library.uq.edu.au
Extension: 52367

Students with disabilities:

Any student with a disability who may require alternative academic arrangements in the course is encouraged to seek advice at the commencement of the semester from a Disability Adviser at Student Support Services.

Assistance for Students:

Students with English language difficulties should contact the course coordinator or tutors for the course.

Students with English language difficulties who require development of their English skills should contact the Institute for Continuing and TESOL Education on extension 56565.

The Learning Assistance Unit located in the Relaxation Block in Student Support Services. You may consult learning advisers in the unit to provide assistance with study skills, writing assignments and the like. Individual sessions are available. Student Support Services also offers workshops to assist students. For more information, phone 51704 or on the web http://www.sss.uq.edu.au/index.html.
Student Liaison Officer:

The School of Physical Sciences has a Student Liaison Officer as an independent source of advice to assist students with resolving academic difficulties.

The Student Liaison officer during 2004 will be Dr Peter Adams, Room 547 Priestley building, (email pa@maths.uq.edu.au)

Program of work for the semester:

1. Algebras and sigma algebras.
3. Outer measures.
4. Lebesgue measure.
5. Completeness and regularity.
7. The construction of the Lebesgue integral.
8. The Riemann integral versus Lebesgue integral.
9. Modes of convergence.
10. Spaces of Lebesgue integrable functions.
11. Dual spaces.
12. Signed measures.
13. Absolute continuity.