ACE Network Subject Information Guide

MATH7907 Advanced Methods in Mathematics 1

Semester 1 2023

Administration and contact details

Host department	School of Mathematical and Physical Sciences
Host institution	Macquarie
Name of lecturer	Paul Bryan
Phone number	
Email address	paul.bryan@mq.edu.au
Homepage	https://pabryan.github.io
Name of honours coordinator	Ji Li
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Name of masters coordinator	Ji Li
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Subject details

Handbook entry URL	
Subject homepage URL	https://pabryan.github.io/dg
Honours student hand-out URL	
Teaching period (start and end date):	20/02/2023-02/06/2023
Exam period (start and end date):	N/A
Contact hours per week:	3 (2 x 1.5 hour lectures)
ACE enrolment closure date:	
Lecture day(s) and time(s):	Thursday 11am-1pm
	Friday 1pm-3pm
Description of electronic access arrangements for students (for example, LMS)	Zoom, course webpage

Subject content

1. **Subject content description**

   We will start with the classical theory of curves and surfaces, but presented in a modern way that leads naturally and directly to the general theory of manifolds and Riemannian geometry. We will develop the formalism of manifolds, differential forms, vector bundles, Riemannian metrics and curvature, then apply these to global topics relating topology and curvature such as the Gauss-Bonnet theorem, classification of constant sectional curvature manifolds, and time permitting some theorems in comparison geometry such as the Bonnet-Myers theorem.

2. **Week-by-week topic overview**

   Week 01: Curves
   Week 02: Global Curve Theory
   Week 03: Surfaces
   Week 04: Geometry and Curvature of Surfaces
   Week 05: Manifolds
   Week 06: Manifolds
   Week 07: Vector fields
   Week 08: Tensor Bundles
   Week 09: Differential Forms
   Week 10: Riemannian metrics and connections
   Week 11: Metric space structure
   Week 12: Intrinsic an Extrinsic curvature
   Week 13: Global Topics

3. **Assumed prerequisite knowledge and capabilities**

   The prerequisites for the course are linear algebra and multi-variable/vector calculus. Familiarity with topology and analysis, particularly differential equations will also be beneficial but is not necessary.

4. **Learning outcomes and objectives**

Understand fundamental topics in differential geometry.

AQF specific Program Learning Outcomes and Learning Outcome Descriptors (if available):

AQF Program Learning Outcomes addressed in this subject	Associated AQF Learning Outcome Descriptors for this subject
Insert Program Learning Outcome here	Choose from list below
Insert Program Learning Outcome here	Choose from list below
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Insert Program Learning Outcome here	Choose from list below
Insert Program Learning Outcome here	Choose from list below
Insert Program Learning Outcome here	Choose from list below

Learning Outcome Descriptors at AQF Level 8

Knowledge

K1: coherent and advanced knowledge of the underlying principles and concepts in one or more disciplines

K2: knowledge of research principles and methods

Skills

S1: cognitive skills to review, analyse, consolidate and synthesise knowledge to identify and provide solutions to complex problem with intellectual independence

S2: cognitive and technical skills to demonstrate a broad understanding of a body of knowledge and theoretical concepts with advanced understanding in some areas

S3: cognitive skills to exercise critical thinking and judgement in developing new understanding

S4: technical skills to design and use in a research project

S5: communication skills to present clear and coherent exposition of knowledge and ideas to a variety of audiences

Application of Knowledge and Skills

A1: with initiative and judgement in professional practice and/or scholarship

A2: to adapt knowledge and skills in diverse contexts

A3: with responsibility and accountability for own learning and practice and in collaboration with others within broad parameters

A4: to plan and execute project work and/or a piece of research and scholarship with some independence

5. Learning resources

http://pabryan.github.io/dg

6. Assessment

Exam/assignment/classwork breakdown					
Exam		**Assignment**	100	**Class work**	
Assignment due dates		Week 4	Week 7	Week 10	**Week 13**
Approximate exam date				**N/A**	

Institution honours program details

Weight of subject in total honours assessment at host department	12.5%
Thesis/subject split at host department	
Honours grade ranges at host department	
H1	85
H2a	75
H2b	65
H3	50

Institution masters program details

Weight of subject in total masters assessment at host department	12.5%
Thesis/subject split at host department	
Masters grade ranges at host department	
H1	85
H2a	75
H2b	65
H3	50