Subject Information Guide

Fractional Calculus

Semester 1, 2015

Administration and contact details

Host Department	School of Mathematics and Applied Statistics
Host Institution	University of Wollongong
Name of lecturer	Dr Marianito Rodrigo
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Subject details

Handbook entry URL	
Subject homepage URL	
Honours student hand-out URL	
Start date:	2 March 2015
End date:	5 June 2015
Contact hours per week:	3
Lecture day and time:	Friday 10:30-13:30
Description of electronic access arrangements for students (for example, WebCT)	Resources will be hosted and available for download from the lecturer's website. Details will be given at the commencement of the course.

Subject content

1. Subject content description

We will cover the basics of fractional calculus, or more aptly called the calculus of derivatives and integrals to an arbitrary order. We will start with a historical survey and consider some special functions that are frequently used in this field. Then we define the Riemann-Liouville fractional integral and examine its properties. This fractional integral leads us to the definitions of the Riemann-Liouville and Caputo fractional derivatives. We will look at the calculus of these derivatives, as well as their Laplace transforms. Then we will study fractional differential equations and consider some of their applications. A different definition of the fractional integral and derivative will lead us to consider the Weyl fractional calculus. Finally, depending on the available time, we will study the numerical solution of fractional differential equations.

2. Week-by-week topic overview

Topics covered are:

- Historical overview
- Some special functions
- Riemann-Liouville fractional integral
- Riemann-Liouville fractional derivative
- Caputo fractional derivative
- Solution of fractional differential equations
- Applications of fractional calculus
- Weyl fractional calculus
- Numerical solution of fractional differential equations

3. Assumed prerequisite knowledge and capabilities

- Ordinary differential equations, including Laplace transforms
- Basic real analysis, including uniform convergence
- Some familiarity with the Lebesgue integral on the real line is highly recommended but not required

4. Learning outcomes and objectives

At the end of this course, the student will be able to

- Explain briefly the historical development of the fractional calculus from the time of Euler to the present.

- Define the Riemann-Liouville fractional integral and evaluate fractional integrals of some common functions.
- Define the Riemann-Liouville and Caputo fractional derivatives and find the fractional derivatives of some common functions.
- State sufficient conditions under which the fractional integrals and derivatives exist.
- Solve linear fractional differential equations using the Laplace transform.
- Investigate some applications of the fractional calculus to the real world.
- Define and calculate the Weyl fractional integrals and derivatives of some common functions.
- Solve fractional differential equations numerically using Octave/MATLAB.

5. Learning resources

Lecture notes and other resources in PDF format will be available from the lecturer's website.

6. Assessment

Exam/assignment/classwork breakdown					
Exam	60%	Assignment	40%	Class work	0%
Assignment due dates	TBA				
Approximate exam date				12 June 2015	

Institution Honours program details

Weight of subject in total honours assessment at host department	1/8
Thesis/subject split at host department	BMath (Hons): Thesis worth 25% BMathAdv (Hons): Thesis worth 37.5%
Honours grade ranges at host department:	
H1	85-100
H2a	75-84
H2b	65-74
H3	50-64