ACE Network Subject Information Guide

An introduction to Partial Differential Equations

Semester 2, 2021

Administration and contact details

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Host institution	Monash University
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Subject details

Handbook entry URL	https://handbook.monash.edu/2020/units/MTH5123
Subject homepage URL	
Honours student hand-out URL	
Start date:	26 July
End date:	22 October
Contact hours per week:	
Census date:	31 August
Lecture day(s) and time(s):	
Description of electronic access arrangements for students (for example, WebCT)	

Subject content

1. Subject content description

Partial Differential Equations are ubiquitous in the modelling of physical phenomena. This topic will introduce the modern theory of partial differential equations of different types, in particular the existence of solutions in an appropriate space. Fourier analysis, one of the most powerful tools of modern analysis, will also be covered. The following topics are covered in the unit: Sobolev spaces theory (weak derivatives, continuous and compact embeddings, trace theorem); elliptic equations (weak solutions, Lax-Milgram theorem); Parabolic equation (existence, maximal principle); Hyperbolic and dispersive equations (well-posedness).

2. Week-by-week topic overview

1 Lp function space and linear None operators
2 Fourier transform: L1 theory
3 Fourier transform: L2 theory
4 Schwartz distributions
5 Application I: linear equations
6 Application II: nonlinear equations
7 Fourier multiplier and function
8 Sobolev inequalities, Embedding
9 Function space on the domain I
10 Function space on the domain II
11 Elliptic equations, Weak derivatives
12 Existence of weak solutions, Lax-Milgram Theorem

3. Assumed prerequisite knowledge and capabilities

Real analysis
Functional analysis (Banach space, Hilbert space, linear operator),
Measure theory (Lebesgue integration)

4. Learning outcomes and objectives

- Synthetise advanced mathematical knowledge in the basic theory of fundamental PDEs.
- Interpret the construction of `generalised functions' (distribution) and how it relates to modern notions of derivative and function spaces.
- Synthetise techniques and properties of Fourier Analysis.
- Apply sophisticated Fourier analysis methods to problems in PDEs and related fields.
- Apply recent developments in research on PDEs

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
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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

Lecture notes for printout.

6. Assessment

Exam/assignment/classwork breakdown					
Exam	60%	**Assignment**	40%	**Class work**	
Assignment due dates		Click here to enter a date.	Click here to enter a date.	Click here to enter a date.	Click here to enter a date.
Approximate exam date				Click here to enter a date.	

Institution honours program details

Weight of subject in total honours assessment at host department	1/16
Thesis/subject split at host department	thesis is worth 1/4 of the whole Master
Honours grade ranges at host department	
H1	HD: 80% and above
H2a	D: 70-79%
H2b	C: 60-69%

H3	P: 50-59%

Institution masters program details

Weight of subject in total masters assessment at host department	1/16
Thesis/subject split at host department	thesis is worth 1/4 of the whole Master
Masters grade ranges at host department	
H1	HD: 80% and above
H2a	D: 70-79%
H2b	C: 60-69%
H3	P: 50-59%