University of Alberta
Department of Mathematical & Statistical Sciences

MATH 438: Intermediate PDEs II
Winter 2014

Instructor:	Prof. Rouslan Krechetnikov
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Office Hours:	Tue 12:30-2:30 pm
Lecture Room & Time:	Tue/Thu 11:00-12:20 at CAB 373, beginning with January 7 and ending on April 8
Course Web Page:	www.math.ualberta.ca/∼ rkrechet/files/teaching/current/

Course Description:
Second order equations in n dimension: classification, canonical form, characteristic surfaces. Laplace equation as a representative of the elliptic equation: the mean value theorem, fundamental solutions and Green functions, the boundary value problems. Wave equation as a representative of hyperbolic equations: initial value problems, the d'Alambert formula, the method of descent, propagation of singularities, Duhamel's principle. Heat equation as a representative of parabolic equations: initial value problems. Introduction to integral transforms: Fourier, Laplace, Hankel transforms.

Course Prerequisites:
MATH 337: It is important to prepare yourself for this course through a review of the prerequisite material.

Course Objectives and Expected Learning Outcomes:
This course offers a concise, but self-contained, introduction to the fascinating subject of partial differential equations (PDEs), which would combine physical insights, efficient solution techniques, and mathematical rigor. We will value both heuristic and rigorous considerations but at the same time maintain high mathematical standards, which is important in order to penetrate into the research world and any serious literature. The goal is to expose the PDE theory such that all the solution techniques have a unified mathematical function-analytic foundation and, on the other hand, the rigorous function-analytic ideas have a clear physical motivation.

Lecture Schedule & Assigned Readings:

Week	Dates	Topic	Readings
1	January 7	Introduction	M Intro, §1, Z§1,2
	January 9	Characteristics	M§2.2, Z§3
2	January 14	Canonical forms	M§2.2, Z§3
	January 16	Laplace equation: introduction	M§4.1, Z§8.4
3	January 21	Laplace equation: potential theory, Green's functions	M§4.2, Z§7.1,7,3
	January 23	Laplace equation: other properties	M§4.2,4.4, Z§7.1,7.3,7.5,8.1
4	January 28	Wave equation: introduction	M§3.1
	January 30	Wave equation: higher dimensions	M§3.2
5	February 4	Wave equation: other properties	M§3.2,3.3, Z§7.1,7.3,7.4
	February 6	Heat equation: introduction	M§5.1
6	February 11	Heat equation: initial value problem	M§5.2, Z§7.3,7.4
	February 13	Heat equation: other properties	M§5.3,5.4
7	February 18	Reading week	
	February 20	Reading week	
8	February 25	Midterm	
	February 27	Linear functional analysis: spaces, operators	M§6.1
9	March 4	Linear functional analysis: generalized solutions	M§2.3, Z§7.2
	March 6	Linear functional analysis: Dirichlet problem	M§6.2
10	March 11	Linear functional analysis: PDE operators	M§6.6
	March 13	Integral transforms: Fourier	M§5.2, Z§5.2-5.4
11	March 18	Integral transforms: Fourier	M§5.2, Z§5.2-5.4
	March 20	Integral transforms: Fourier	M§5.2, Z§5.2-5.4
12	March 25	Integral transforms: Laplace	Z§5.6
	March 27	Integral transforms: Laplace	Z§5.6
13	April 1	Integral transforms: Laplace	Z§5.6
	April 3	Integral transforms: asymptotics	Z§5.7
14	April 8	Integral transforms: general & Hankel	Z§5.5

Textbook:
combination of chapters 3-6 from Partial Differential Equations: Methods and Applications by Robert C. McOwen (2002, 2nd edition) and chapters 5-7 from Partial Differential Equations of Applied Mathematics by Erich Zauderer, Wiley-Interscience (2006, 3rd edition)

Grade Evaluation:
The course mark will be calculated based on the following breakdown:

Course Component	Weight of Total Mark	Date
Assignments	20%	1/14, 1/28, 2/25, 3/11, 3/25
Midterm	30%	2/25
Final Exam	50%	4/15 at 9:00 am

Note: The date of the final examination is set by the Registrar and takes precedence over the final examination date reported in this document. Students must verify this date on BearTracks when the Final Exam Schedule is posted.

The final letter grade will be determined from the course mark as follows. An overall course mark of 50% or more guarantees a passing grade of at least D. An overall course mark of 90% or more guarantees a grade of at least A.

Grades are unofficial until approved by the Department and/or Faculty offering the course.

Assignments:
There will be five assignments to be handed out (posted on the web) on January 14 (due January 28) and January 28 (due February 11), February 25 (due March 11), March 11 (due March 25) and March 25 (due April 8).

Policy: collaboration on homework assignments is allowed. However all solutions that are handed in should reflect your understanding of the subject matter at the time of writing. All written work should be of the individual student. The homeworks are due by 11:00 am (right before the class) on Tuesdays lecture. No late homework papers will be accepted.

Representative Evaluative Material:
Hard copies of representative examples for midterm and final examinations will be provided to all students.

Exam Format:
The format of the exams will be the same as that of representative evaluative material that to be provided to the students.

Exam Aids:
closed-book, no collaboration is allowed; the use of calculators and computers is not permitted in the examinations.

Missed Assignment/Lab:
No late homework papers will be accepted.

Missed Midterm:
A student who cannot write a midterm due to incapacitating illness, severe domestic affliction or other compelling reasons can apply for an excused absence. To apply for an excused absence, the student must present supporting documentation pertaining to the absence to the instructor within two working days following the scheduled date of the missed term work, or as soon as the student is able. In the case of an incapacitating illness, either a medical

note or a statutory declaration (which can be obtained at the student's Faculty Office) will be accepted.

There will be no make-up/deferred midterm exam. In case when a student misses an exam due to a substantiated reason, the weight of the midterm will be transferred to the final.

An excused absence is a privilege and not a right; there is no guarantee that an absence will be excused. Misrepresentation of Facts to gain an excused absence is a serious breach of the Code of Student Behaviour.

Missed Final Examination:
A student who cannot write the final examination due to incapacitating illness, severe domestic affliction or other compelling reasons can apply for a deferred final examination. Such an application must be made to the student's Faculty office within 48 hours of the missed examination and must be supported by a Statutory Declaration (in lieu of a medical statement form) or other appropriate documentation (Calendar section 23.5.6). Deferred examinations are a privilege and not a right; there is no guarantee that a deferred examination will be granted. Misrepresentation of Facts to gain a deferred examination is a serious breach of the Code of Student Behaviour.

Any deferred final examinations are scheduled as follows:

Date: Saturday May 3, 2014
Time: 9:00am
Location: Students should meet outside CAB 357 at 8:30am to register for their exam.

Re-examination:
A student who writes the final examination and fails the course may apply for a re-examination. Re-examinations are rarely granted in the Faculty of Science. These exams are governed by University (Calendar section 23.5.5) and Faculty of Science Regulations (Calendar section 192.5.9). Misrepresentation of Facts to gain a re-examination is a serious breach of the Code of Student Behaviour.

STUDENT RESPONSIBILITIES

Academic Integrity:
The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behaviour (online at www.governance.ualberta.ca) and avoid any behaviour which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an

offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

All forms of dishonesty are unacceptable at the University. Any offense will be reported to the Senior Associate Dean of Science who will determine the disciplinary action to be taken. Cheating, plagiarism and misrepresentation of facts are serious offenses. Anyone who engages in these practices will receive at minimum a grade of zero for the exam or paper in question and no opportunity will be given to replace the grade or redistribute the weights. As well, in the Faculty of Science the sanction for cheating on any examination will include a disciplinary failing grade (no exceptions) and senior students should expect a period of suspension or expulsion from the University of Alberta.

Collaboration on Assignments:
Collaboration on homework assignments is allowed. However all solutions that are handed in should reflect your understanding of the subject matter at the time of writing. All written work should be of the individual student.

Exams:
Your student photo I.D. is required at exams to verify your identity. Students will not be allowed to begin an examination after it has been in progress for 30 minutes. Students must remain in the exam room until at least 30 minutes has elapsed. Electronic equipment cannot be brought into examination rooms.

Cell Phones:
Cell phones are to be turned off during lectures, labs and seminars. Cell phones are not to be brought to exams.

Audio or Video Recording:
Audio or video recording of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan. Recorded material is to be used solely for personal study, and is not to be used or distributed for any other purpose without prior written consent from the instructor.

Students with Disabilities:
Students who require accommodation in this course due to a disability are advised to discuss their needs with Specialized Support & Disability Services (2-800 Students' Union Building).

Student Success Centre:
Students who want to improve their learning and academic capacity (such as better time management, study skills or examination skills) are encouraged to contact the Student Success Centre (2-300 Students' Union Building).

Decima Robinson Support Centre for Mathematical & Statistical Sciences:
Students who require additional help with assignments or have questions about the course material in general are encouraged to visit the Decima Robinson Support Centre (528 Central

Academic Building). Graduate students will be available to provide one-on-one help. In order to get maximum help during each visit, students are asked to be specific about the problem with which they are seeking help. The Centre is open Monday to Friday, 9:00–15:00.

Policy about course outlines can be found in section 23.4(2) of the University Calendar.

Disclaimer:
Any typographical errors in this Course Outline are subject to change and will be announced in class.