Partial Differential Equations

Term: Fall 2016, Course listed as MA455 (Class B)

Instructor: Dr Roderick Melnik
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Office hours: Tuesday, Thursday 13:00 - 13:30, 16:00-16:30 or by appointment

Pre-requisites: MA104 or MA200, MA201 and MA205, and a 0.5 MA credit at the 300 level, or permission of the department.

Course form: Lectures, homework assignments, and tests.

Timetable: Classroom BA112, Days: Tuesday and Thursday 2:30 - 3:50pm.

Course outline: The course consists of two lectures a week, one assignment, one test during the semester, and the final examination.
This course is the study of some of the most fundamental mathematical models and methodologies for their solution. It should give a good background for your further progress in applied mathematics, including financial mathematics, and mathematical modelling for science and engineering.
Lectures in this course will be given close enough to the text:
[1] Rich Haberman, Applied Partial Differential Equations, 4th Edition (or later editions), Pearson.
However, it is not compulsory to buy this book. Some students may already have the text:
[2] Nagle, Saff, and Snider, Fundamentals of Differential Equations, 6th Edition (or later editions), Pearson.
The latter book is a good introductory book to the subject. It covers a substantial number of the topics that will be discussed in the class. Hence, if you decide to skip buying [1], text [2] could be useful, but your lecture notes should be sufficient.
Another book that we consider to be useful (along with many others that you can find in the library) is:
[3] Peter Olver, Introduction to Partial Differential Equations, Springer, 2014.

During the Fall semester you will be introduced to *a selection* of the following topics:

- Basic concepts. PDEs as fundamental mathematical models in science and engineering.
- Model for the conduction of heat. Derivation, boundary and initial conditions. Higher dimensional models and their representations in Cartesian and other coordinate systems.
- Classification of PDEs. Linear and nonlinear PDEs.
- Linearity, superposition principle, and the method of separation of variables. Laplace's and Poisson's equations.
- Orthogonality, self-adjoint operators, Sturm-Liouville problems, Rayleigh quotients, Fourier series and their applications in the method of eigenfunction expansion.
- Modelling vibrating strings and membranes.
- Numerical methodologies for PDEs and applications.
- Green's functions for time-independent problems, Dirac's delta function, and fundamentals of integral equations.
- Nonlinear PDE-based models and their applications in science and finance.

Policy statement: Your attendance and promptness are quite important for this class.

- For general University rules see the Laurier Catalog (highlights are given in the end of this statement).
- You are encouraged to collaborate on different aspects of this course with your fellow students, excluding your test and the final examination.
- Exercises will be distributed on a regular basis. Some of these problems you will be required to submit as your homework assignments. Which particular problems you will need to submit as part of your assignments will be announced in the class in 3 installments. The result should be submitted as one single piece of work by 2:30pm, November 24, 2016. After this date, no assignments will be accepted under no circumstances. Graded assignments will be returned to you on December 1, 2016.
- Even though not all problems will be required to present in writing, students are urged to attempt all given problems and to seek help if difficulties are encountered. Note that during the test and the final exam, your skills in solving problems such as those given to you in the class are essential. Success in this course usually depends on your regular practice.
- A student who is forced to miss the exam must notify the instructor no later than the day of the exam, or a grade of zero will be recorded. There are no deferred midterm exams in this course. A missed exam without a valid, documented excuse (e.g., medical certificate) will be assigned a mark of zero. The value of a missed exam for legitimate reasons will be assigned to the Final Exam in proportion to its value.
- Students are expected to be aware of and abide by all University regulations and policies, as outlined in the current Academic Calendar. In particular:

  1. Students must reserve the examination period of December 10–21, 2016 (including Sundays). If you are considering registering for a special examination or event, you should select a time outside the examination period. Consult Academic Regulations in the Academic Calendar for special circumstances for examination deferment.
  2. Students with disabilities or special needs are advised to contact Lauriers Accessible Learning Centre for information regarding its services and resources. Students are encouraged to review the Academic Calendar, `http://legacy.wlu.ca/calendars/index.php?cal=1&y=69`, for information regarding all services available on campus.
  3. he University has a defined policy with respect to Academic Misconduct; penalties are severe and enforced at all times. You are responsible for familiarizing yourself with the academic misconduct policy and penalty guidelines, and are cautioned that, in addition to failure in a course, students may be suspended or expelled from the University for academic misconduct, and the offence may appear on their transcripts. The relevant policy can be found at Laurier's academic integrity website along with resources to educate and support you in upholding a culture of integrity; see `http://legacy.wlu.ca/homepage.php?grp_id=1865`. **Ignorance of Lauriers academic misconduct policy is not a defence**. Academic Misconduct includes transmission or reception of information, or possession of unauthorized information, during laboratories, quizzes, tests, or examinations. Academic Misconduct also includes plagiarism. Wilfrid Laurier University uses software that can check for plagiarism, and students may be required to submit their written work in electronic form for a plagiarism check. The *Student Code of Conduct and Discipline* and the procedures for investigating and determining appropriate disciplinary measures for breaches of this Code are given in the Academic Calendar; see `http://legacy.wlu.ca/page.php?grp_id=2505&p=11452`.
  4. The use of electronic devices in the classroom is governed by WLU Policy 9.3: Policy on the Classroom Use of Electronic Devices; see `http://legacy.wlu.ca/documents/50202/9.3_Electronic_Device_Policy.pdf`. Details of this Policy and the consequences of breaches are stated in the Academic Calendar. Mobile devices, specifically laptops and tablets, may be used in class only for educational (learning) purposes directly related to the course. Those who choose to use such devices for reasons other than accessibility may be asked to sit at the back of the room. Use of other mobile devices is not permitted in class. Off-task use of mobile devices, such as facebook or texting, is prohibited. Students who fail to comply with this policy may be asked to stow their devices at the front of the classroom, or to leave the classroom.
  5. Course Drop Dates Fall 2016 are:
     - September 14: Last day to drop/withdraw from 12-week course(s) at no tuition charge (provided the student remains registered in at least one course).
     - September 21: Last day to drop/withdraw from 12-week course(s) at 10 percent tuition charge (tuition charge assessed at 10% of the course rate).

– November 9: Last day to drop/withdraw from 12-week course(s) without failure and for possible tuition adjustment (tuition charge assessed at 55% of the course rate).

Assessment: The assessment in this course will consist of one assignment given to you during the term in 3 installments (10% each), one test (30%, October 27, 2016, 17:30–18:50, P1025/P1027) and the final open-book examination (40%, 2.5 hours). During your mid-term test and final examination non-programmable, non-graphing calculators are permitted. The final mark will be converted to a letter grade in accordance with the conversion table given in the University Calendar. In the event of a question regarding a test mark or the final grade, it is the responsibility of the student to retain and present graded materials which are returned for student possession during the term. Students have one week from the day marked material is returned in class to appeal their grade. No marks will be changed after that time.

Course material and auxiliary references: Your lecture notes are sufficient. During your studies, you may wish to supplement them by one of several textbooks. Some of auxiliary references may be posted to the course website at `http://www.m2netlab.wlu.ca/teaching/courses.html`, including some software links for those who would like to master the subject at a higher level. In addition to the three texts and lecture notes mentioned above, there is a wealth of materials for this course and you can find a number of texts that may be useful for the course and for your own future work. Although the use of additional literature is not required for this course, it is highly encouraged.

Good luck!