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## UBC Math 316: Elementary Differential Equations II

### May-August 2014

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This page provides official background information for two courses running in parallel:

- UBC Math 257 — Partial Differential Equations, and
- UBC Math 316 — Elementary Differential Equations II.

Daily readings, homework, and updates, are on the courses' [Unified Home Page](#).

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### Instructor

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**Dr. Philip D. Loewen**

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<b>Email</b>	<a href="mailto:loew@math.ubc.ca">loew@math.ubc.ca</a> (try this first)
<b>Office phone</b>	604-822-3082 (urgent cases only, please)
<b>URI</b>	<a href="http://www.math.ubc.ca/~loew/">http://www.math.ubc.ca/~loew/</a>
<b>Office Hours</b>	Drop-in hours are shown below. Meetings outside these hours can also be arranged, but please reserve a time by email beforehand. Unexpected visitors often cannot be accommodated. <i>If you expect to need more than 15 minutes, please make an appointment.</i>

### May-June 2014\*

Mon	Tue	Wed	Thu	Fri
14:00-16:00	16:00-16:30	[none]	16:00-16:30	14:00-16:00

\* I will be unavailable on some days. Please check "Daily Specials" below before trekking to MATH 207.

**Daily Specials**      NONE: This week looks normal so far.

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### Topic Outline

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Topic	Hrs	Description
<b>Review of Series</b>	<b>5</b>	<ul style="list-style-type: none"> <li>• Convergence concepts</li> <li>• Geometric series and the ratio test</li> <li>• Error control and Shanks Transformation</li> <li>• Power series</li> <li>• Analytic functions, radius of convergence</li> </ul>
<b>Linear Ordinary Differential Equations</b>	<b>9</b>	<ul style="list-style-type: none"> <li>• Power Series Solutions near an ordinary point                             <ul style="list-style-type: none"> <li>◦ General Solutions</li> <li>◦ Initial-Value Problems</li> <li>◦ Non-homogeneous problems</li> </ul> </li> <li>• Homogeneous ODE's with Constant Coefficients</li> <li>• Non-Homogeneous ODE with Constant Coefficients</li> <li>• ODE's of Euler type</li> <li>• Change of independent variable</li> <li>• Singular points: regular vs irregular</li> <li>• Series solutions near a regular singular point (Frobenius method)</li> </ul>
<b>Linear Operators and Eigenvalue Problems</b>	<b>6</b>	<ul style="list-style-type: none"> <li>• The matrix case</li> <li>• Operators and eigenvalues in function space</li> <li>• Sample eigenvalue problems</li> </ul>

<b>Eigenfunction-series solutions for Boundary-Value Problems</b>	<b>6</b>	<ul style="list-style-type: none"> <li>• Orthogonality and eigenfunction series</li> <li>• Separation of variables: eigenvalue problems, formal series</li> <li>• The Big Four standard eigenvalue problems</li> <li>• Propagating coefficients</li> <li>• Initialization</li> <li>• Special modes; superposition</li> <li>• Nonhomogeneous PDE</li> <li>• Nonhomogeneous BC</li> </ul>
<b>More General Eigenfunction Series</b>	<b>5</b>	<ul style="list-style-type: none"> <li>• Eigenvalue Problems</li> <li>• Orthogonality and Eigenfunction Series</li> <li>• Sturm-Liouville Theory</li> <li>• Full Fourier Series</li> </ul>
<b>Heat Equation in Depth</b>	<b>3</b>	<ul style="list-style-type: none"> <li>• Derivation; BC's and their meanings</li> <li>• Transient versus long-run behaviour</li> <li>• Splitting methods for nonhomogeneous boundary conditions</li> </ul>
<b>Laplace's Equation in Depth</b>	<b>4</b>	<ul style="list-style-type: none"> <li>• Derivation and Interpretation</li> <li>• Superposition and splitting</li> <li>• Neumann problems and consistency conditions</li> <li>• Physical solutions are bounded functions</li> <li>• Problems in polar coordinates (Euler equations reappear)</li> </ul>
<b>Wave Equation in Depth</b>	<b>4</b>	<ul style="list-style-type: none"> <li>• Derivation; BC's and their meanings</li> <li>• Travelling wave solutions</li> <li>• D'Alembert's solution</li> <li>• Signal speed; reflections</li> <li>• Forcing and resonance</li> </ul>
<b>Numerical Methods</b>	<b>2</b>	<ul style="list-style-type: none"> <li>• Finite Differences</li> <li>• Spreadsheet Implementations</li> </ul>
<b>Total Hours on Outline</b>	<b>44</b>	• (44 lecture-hours + 2 test-hours = 46 meetings this term)

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### Course Details

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**Required Text:**

- William F. Trench, *Elementary Differential Equations with Boundary Value Problems*, 2013. Book 9 in the collection *Books and Monographs* available free online at <http://digitalcommons.trinity.edu/mono/9>.

**Recommended Reading:** Watch the main [course page](#) for writeups customized for this term's experience. In addition, consult the following:

- W. E. Boyce and R. C. DiPrima, *Elementary Differential Equations and Boundary Value Problems*, any edition since about #5. New York: John Wiley & Sons, 1997.
- Froese, Richard G., [Partial Differential Equations](#). UBC M257/316 Lecture notes free on the Web.
- Peirce, Anthony, [UBC M257/316 course page for Sep-Dec 2013](#). Look especially at the section headed "Lecture Notes".

**Other Nice Books:**

- Churchill, R. V., and J. W. Brown, *Fourier Series and Boundary Value Problems*. New York: McGraw-Hill, 1993.
- Troutman, John L., *Boundary Value Problems of Applied Mathematics*. Boston: PWS Publishing Company, 1994.
- Main, Iain G., *Vibrations and Waves in Physics*, third edition. Cambridge University Press, 1993.

**Important Dates:**

- Tuesday 13 May: Class starts, 14:00 in room LSK 200.
- Thursday 19 June: Midterm test in class. 90 minutes.
- Friday 20 June – Wednesday 2 July: no classes.
- Thursday 3 July: Classes resume after mid-session break.
- Thursday 7 August: Last class of the term.

- Tuesday 12 August – Saturday 16 August: Official exam period.

**Evaluation:**

- Daily Participation (bring your iClicker to class), 0-2%.
- Weekly Homework (Due every Tuesday), 10%.
- 19 June 2014 (Thursday), Midterm Exam, 38-40%, in class.
- 12-16 August 2014, Final Exam, 50%, scheduled by UBC Enrolment Services.

**Policies:**

- Students may use **no resources except for writing equipment** on midterm and final examinations. This means **no formula sheet** and **no calculator**. Seriously.
- The final course grade is influenced only by what knowledge of the subject students demonstrate in the activities described above.
- There is no supplemental examination in this course.
- Missing a midterm normally results in a mark of 0. Exceptions may be granted in two cases: prior consent of the instructor or a medical emergency. In the latter case, the instructor must be notified within 48 hours of the missed test, and presented with a doctor's note immediately upon the student's return to UBC.

**Course Web Page (daily details appear here):** <http://www.math.ubc.ca/~loew/m316/>

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Last update: 12 May 2014 (Mon), 12:00:10.



(Click a graphic to recheck.)