Study Guide 2017–2018

Tensor Calculus and Differential Geometry

2WAH0



Luc Florack

March 6, 2018

Cover illustration: papyrus fragment from Euclid's Elements of Geometry, Book II.

Recommended Schedule for Exam Preparation

2WAH0 credit: $5 \text{ ECTS} \sim 140 \text{ hours}$, divided over 8 weeks.

$8 \times 3 =$	24	old exams, regular time
$8 \times 3 =$	24	old exams, extra time
$8 \times 4 =$	32	oral lectures, attendance
	70	course notes, written annotations, old exams, self study

140 total (5 ECTS)

P.S.:

- Time allocated for practicing with old exams includes $8 \times 2 = 16$ hours (1/3rd of 48 hours) for supervised learning sessions.
- A typical exam should take no more than 3 hours after course completion and exam preparation. Extra time is reserved for old exams in the learning phase.
- Please use the old exams and the solutions provided as complementary study material to the course notes and oral lectures.
- Don't underestimate the normative effort expected for self study, nearly ten (!) hours per week *on top of* the hours recommended for old exams and class attendance ...
- There is no interim test.
- Threshold final exam: 6 (out of 10).
- This is a tentative study guide (last update: March 6, 2018). Please consult regular updates!

2_____

Tentative Schedule

Tuesday February 6 2018:

• Chapter 1.

Thursday February 8 2018, supervised learning:

• Problem Companion.

Thursday February 8 2018:

- Section 2.1: Vector Spaces and Bases.
- Section 2.2: Dual Vector Spaces and Dual Bases.

Tuesday February 20 2018:

- Section 2.3: The Kronecker Tensor.
- Section 2.4: Inner Products.
- Section 2.8.1: Tensors in all Generality.

Thursday February 22 2018, supervised learning:

• Problem Companion.

Thursday February 22 2018:

• Section 2.8.2: Tensors Subject to Symmetries.

Tuesday February 27 2018:

CANCELLED.

Thursday March 1 2018, supervised learning:

CANCELLED.

Thursday March 1 2018:

CANCELLED.

Tuesday March 6 2018:

- Section 2.8.3: Symmetry and Antisymmetry Preserving Operators.
- Section 2.8.4: Vector Spaces with an Oriented Volume.

Thursday March 8 2018, supervised learning:

- Thursday April 23, 2009, problem 1.
- Thursday April 23, 2009, problem 2.
- Thursday April 23, 2009, problem 3.
- Monday June 15, 2009, problem 1.
- Monday June 15, 2009, problem 3.
- Monday April 11, 2011, problem 1.
- Friday July 1, 2011, problem 1. item Tuesday June 23, 2015, problem 1.
- Wednesday June 26, 2013, problem 1.

Thursday March 8 2018:

- Section 2.8.5: Tensors on an Inner Product Space.
- Section 2.8.6: Tensor Transformations: 2.8.6.1, 2.8.6.2 & 2.8.6.3.
- Section 2.8.7: Contractions (read yourself).
- Section 2.9: The Hodge Star.
- Section 3.1: Euclidean Space: Cartesian and Curvilinear Coordinates.
- Section 3.2: Tangent and Cotangent Bundle.
- Section 3.3: Exterior Derivative.

Tuesday March 13 2018:

• Section 3.4: Affine Connection.

Thursday March 15 2018, supervised learning:

• Thursday April 23, 2009, problem 4.

- Monday June 15, 2009, problem 4.
- Monday April 11, 2011, problem 1.
- Monday April 11, 2011, problem 3.
- Friday July 1, 2011, problem 3.
- Wednesday June 26, 2013, problem 2.
- Tuesday April 7, 2015, problem 1.

Thursday March 15 2018:

- Section 3.5: Lie Derivative.
- Section 3.6: Torsion.
- Section 3.7: Levi-Civita Connection.
- Section 3.8: Geodesics.

Tuesday March 20 2018:

- Section 3.9: Curvature.
- Section 3.10: Push-Forward and Pull-Back.
- Section 3.11: Examples.

Thursday March 22 2018, supervised learning:

- Old exams, all problems.
- Questions & Answers.

Thursday March 22 2018:

• Old exams, some explanations.

Tuesday March 27 2018:

• Old exams, some explanations.

Thursday March 29 2018, supervised learning:

- Old exams, some explanations.
- Old exams, all problems.
- Questions & Answers.

Thursday March 29 2018:

• t.b.d.

Tuesday April 3 2018:

• t.b.d.

Thursday March 29 2018, supervised learning:

- SUPERVISION 10:45–11:30 ONLY.
- Questions & Answers on request.

Thursday April 5 2018:

• t.b.d.