CALCULUS 3 HOMEWORK

- This homework is based on: J. Stewart, "Essential Calculus" (early transcendentals), Thomson Brooks/Cole, 2007
- Homework will not be collected or graded. Nevertheless, it is crucial to do the homework as part of your preparation for the exams. To keep up, I recommend that **after every lecture you should solve the homework problems corresponding to the material covered on that day's lecture.** Do the assigned reading and problems in the specified order.
- CAL3.1, etc. refer to the problems given in the online lecture notes. These notes are available at the course website.
- Problems indicated "for fun" are for math majors.

Vectors in $\mathbb{R}^3$

- **Cartesian coordinates**
  Read §10.1
  §10.1: 7, 9, 13-16, 18-20
  CAL3.1: 1-6
- **Geometric vectors**
  Read §10.2, §10,3
  §10.2: 13-16, 18
  §10.3: 1-8, 11, 13-15
  CAL3.1: 7-11
- **Orthogonality condition**
- **Projections**
  Read §10.3
  §10.3: 17, 18, 20, 21, 22, 23-26, 29,30
  CAL3.1: 12-18
- **Cross Product**
  Read §10.4
  §10.4: 1-7, 9, 13, 17-22
  CAL3.1: 19-24
- **Lines in $\mathbb{R}^3$**
  Read §10.5
  §10.5: 2-10, 11-14
  CAL3.1: 25-30
- **Planes in $\mathbb{R}^3$**
  Read §10.5
  §10.5: 21-30
  CAL3.1: 31-33
- **Relative position of two planes**
  Read §10.5
  §10.5: 33-36, 37, 41, 42
  CAL3.1: 34, 35
- **Distances between points, lines, and planes**
  Read §10.5
  §10.5: 45-48
  CAL3.1: 36

Vector-valued Functions

- **Definitions**
- **Limit of a vector-valued function**
- **Derivative of vector-valued functions**
  Read §10.7 (examples 1-11)
  §10.7: 3, 4, 39-44
  CAL3.2: 1,2,3
- **Properties of differentiation**
  Read §10.7 (differentiation rules)
  §10.7: 75-79
  CAL3.2: 4-9
- **Tangent line to 3d curves**
  Read §10.7 (derivatives)
  §10.7: 49-52
  CAL3.2: 10
- **Integrals of vector functions**
  Read §10.7 (Integrals)
  §10.7: 57-62
  CAL3.2: 11
- **Arclength**

Read 10.8 (examples 1, 2)
§10.8: 1-4
CAL3.2: 12, 13

- **Curvature**
  Read §10.8 (curvature)
  §10.8: 15-19, 21-25, 33, 34
  CAL3.2: 14, 15
- **Tangent, Normal, and Binormal vectors**
  Read §10.8 (Normal and Binormal vectors)
  §10.8: 35, 36, 37, 38, 41, 48
  CAL3.2: 16-19

Scalar fields

- **Definitions**
  Read lecture notes
  Read §11.1
- **Limits of scalar fields**
  Read §11.2
  §11.2: 3, 5-9, 11, 12
- **Continuity**
  Read §11.2
  §11.2: 4, 10, 13, 14, 30
- **Directional and Partial Derivatives**
  Read lecture notes
  Read §11.3, §11.6
  §11.6: 1, 2, 7-9 (without using gradient)
  §11.3: 4-26, 42-50
- **Differentiable scalar fields**
  Read lecture notes
  Read §11.4, §11.6
  §11.4: 11-14, 36
  §11.6: 3-6, 10, 11, 13, 14, 20 (use gradients)
  §11.4: 1-6
- **Chain rule**
  Read §11.5
  §11.5: 13-16, 37-40, 41, 42, 44-46
- **Implicit Differentiation**
  Read §11.5
  §11.5: 21-28
- **Level sets and tangent lines/planes**
  Read §11.6
  §11.6: 31-34, 39, 40, 44

Optimization of scalar fields

- **Maximum and minimum values**
  Read §11.7
  §11.7: 3-14
  CAL3.4: 1, 2, 3
- **Constrained optimization**
  Read §11.8
  §11.8: 1-15
- **Optimization on a bounded set**
  Read §11.8
  §11.8: 16, 17

Multiple Integrals

- **Definition of the double integral**
  Read §12.1
  §12.1: 21-26, 27-29
- **Double integral over a general region**
  Read §12.2
  §12.2: 7-16, 17, 18, 19
- **Change of variables in double integrals**
  Read §12.3
  §12.3: 7-12, 30, 31
- **Definition of the triple integral**
  Read §12.5
  §12.5: 1-8, 11
- **Change of variables in $\mathbb{R}^3$**
  Read §12.6, §12.7
  §12.6: 17. 18, 19, 20, 21
  §12.7: 21-24, 40

Vector Fields

- **Derivatives of a vector field**
  Read lecture notes
  Read §13.1, §13..5
  §13.1: 21-24
  §13.5: 1-7, 21-27, 28, 29, 36
- **Line Integrals**
  Read §13.2 (line integrals of vector fields
  §13.2: 1-6, 12-14, 17-20
- **Basic properties of line integrals**
  Read lecture notes
- **Conservative fields and potential functions**
  Read §13.3

§13.3: 11-18

- **Green's theorem**
  Read §13.4
  §13.3: 27-30
  §13.4: 1-4. 7-12
- **Applications of Green's theorem**
  Read lecture notes
  §13.4: 19,21
  §13.3: 3-10
- **Parametric surfaces**
- **Fundamental product for special surfaces**
  Read lecture notes
  Read §13.6, §13.7
  §13.6: 33-43
  §13.7: 19-27
- **Stokes and Gauss theorems**
  Read lecture notes
  Read §13.8, §13.9
  §13.8: 1, 2, 5, 7, 16
  §13.9: 2-4, 6, 9, 13, 25-30