CALCULUS 3 HOMEWORK

- This homework is based on: J. Stewart, "Essential Calculus" (early transcendentals), 2nd Edition, Thomson Brooks/Cole, 2013
- 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
- **Vector addition and scalar multiplication**
  Read §10,2
  §10.2: 13-16, 18
  CAL3.1: 7,8,9
- **Vector dot product**
  Read §10,3
  §10.3: 1,4,6,15-17
  CAL3.1: 10,11,12,13,14
- **Orthogonality condition**
  Read §10.3
  §10.3: 19,20,21
  CAL3.1: 15-18
- **Projections**
  Read §10.3
  §10.3: 23, 27-32, 33, 41
  CAL3.1: 20
- **Cross Product**
  Read §10.4
  §10.4: 1-7, 13, 17-26
  CAL3.1: 21-24
- **Parallel vectors**
  Read lecture notes
  CAL3.1: 25, 26
- **Lines in $\mathbb{R}^3$**
  Read §10.5
  CAL3.1: 27, 28
- **Planes in $\mathbb{R}^3$**
  Read §10.5
  CAL3.1: 29, 30, 31
- **Distances between points, lines, and planes**
  Read §10.5
  §10.5: 47-50, 53
  CAL3.1: 32, 33, 34

Vector-valued Functions

- **Limit of a vector-valued function**
  Read Lecture Notes
  Read §10.7 (examples 1-7)
  §10.7: 3, 4
  CAL3.2: 1, 2
- **Derivative of vector-valued functions**
  Read §10.7 (examples 8-11)
  §10.7: 39-44
  CAL3.2: 3
- **Properties of differentiation**
  Read §10.7 (differentiation rules)
  §10.7: 75-77
  CAL3.2: 4-9
- **Arclength**
  Read 10.8 (examples 1, 2)
  §10.8: 1-4
  CAL3.2: 10, 11
- **Curvature**
  Read §10.8 (curvature)
  §10.8: 15-17, 21-25
  CAL3.2: 12, 13

Scalar fields

- **Definitions**
  Read lecture notes

Read §11.1

- **Limits of scalar fields**
  Read §11.2
  §11.2: 3, 5, 8, 9, 12
  CAL3.3: 1, 2, 3
- **Continuity of scalar fields**
  Read §11.2
  §11.2: 4, 6, 7, 10, 11, 13-16
  CAL3.3: 4, 5
- **Directional derivatives – definition**
  Read lecture notes
  Read §11.6
  §11.6: 1, 2, 7-9 (without using gradient)
  CAL3.3: 6
- **Directional derivatives and continuity**
  Read Lecture Notes
- **Partial Derivatives**
  Read §11.3
  §11.3: 7-30
  CAL3.3: 7
- **Mixed partial derivatives**
  Read §11.3
  §11.3: 43-50
  CAL3.3: 8-13
- **Application of partial derivatives to error propagation**
  Read Lecture Notes
  CAL3.3: 14
- **Differentiable scalar fields**
  Read lecture notes
  Read §11.4, §11.6
  §11.4: 36
  §11.6: 3-6, 10, 11, 13, 14, 20 (use gradients)
  CAL3.3: 15
- **Chain rule**
  Read §11.5
  §11.5: 13-16
  CAL3.3: 16-22
- **Chain rule and Implicit Differentiation**
  Read §11.5
  §11.5: 22-28
  CAL3.3: 23, 24

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: 1-16
  CAL3.4: 4-8
  CAL3.4: 9, 10 (for fun)
- **Optimization on a bounded set**
  Read §11.8
  §11.8: 17, 19
  CAL3.4: 11

Multiple Integrals

- **Definition of the multiple integrals**
  Read lecture notes
- **Evaluate double integrals in boxed domains**
  Read §12.1
  §12.1: 21-26, 29-31
  CAL3.5: 1, 2
- **Double integral over simple regions**
  Read §12.2
  §12.2: 7-19, 21-23
  CAL3.5: 3
- **Change the order of iterated integrals**
  Reas lecture notes
  CAL3.5: 4, 5
- **Change of variables in multiple integrals**
  Read lecture notes
- **Change of variables to polar coordinates**
  Read §12.3
  §12.3: 7-12, 30, 31
  CAL3.5: 6
- **Evaluation of triple integrals over boxed domains**
  Read §12.5
  CAL3.5: 7
- **Evaluation of triple integrals**
  Read §12.5
  §12.5: 7-14
  CAL3.5: 8
- **Change of variables in $\mathbb{R}^3$**
  Read §12.6, §12.7
  §12.6: 17. 18, 19, 20, 21
  CAL3.5: 9
  §12.7: 21-24
  CAL3.5: 10

Vector Fields

- **Derivatives of a vector field**
  Read lecture notes
  Read §13.1, §13..5
  §13.1: 21-24
  §13.5: 1-7, 36
  CAL3.6: 1-5
  CAL3.6: 6 (for fun)
- **Line Integrals**
  Read §13.2 (line integrals of vector fields
  §13.2: 1, 5, 7, 8 , 13, 14, 15, 16,19-22
- CAL3.6: 7
- **Basic properties of line integrals**
  Read lecture notes
- **Conservative fields and potential functions**
  Read §13.3
  §13.3: 11-18
  CAL3.6: 8,9
- **Green's theorem**
  Read §13.4
  §13.3: 27-30
  §13.4: 1-6. 11-14
  CAL3.6: 10
- **Applications of Green's theorem**
  Read lecture notes
  §13.3: 3-10
  CAL3.6: 11-15
- **Parametric surfaces**
  Read lecture notes
  Read §13.6
  CAL3.6: 16, 17, 10
  §13.6: 32-37
- **Fundamental product for special surfaces**
  Read lecture notes
  Read §13.7
  §13.7: 5-9, 11, 12, 21, 22
  CAL3.6: 19, 20
- **Stokes and Gauss theorems**
  Read lecture notes
  Read §13.8, §13.9
  §13.8: 1, 2, 5, 7 (Stokes theorem)
  CAL3.6: 21, 22, 23 (Stokes theorem)
  §13.9: 2-4, 6, 9, 13, 25-30 (Gauss theorem)
  CAL3.6: 24, 25, 26 (Gauss theorem)