# Mathematics II - tutorials

**Assessment requirements**: Attendance is mandatory - 4 absences are allowed
3 parts:

1. Differential calculus (Ex. 1., 2.) → approximately the end of March
2. Double and Triple integrals (Ex. 3., 4.) → approximately the end of April
3. The rest (Ex. 5., 6.) → the end of the semester

consultations - after the Friday's tutorial (or after e-mail agreement)

## Motivation

Find and sketch a Domain of definition of the following functions:

1. $f(x,y) = \sqrt{x^2+y}$
2. $f(x,y,z) = \ln(z - x^2 - y^2)$

## Quadrics and Geometry repetition

1. Identify the type of a Quadric, its center and other parameters (axes, half-axis ... ):
   (a) $\frac{(x-4)^2}{4} + \frac{(y-1)^2}{4} + \frac{z^2}{8} = 1$
   (b) $(x-2)^2 + (y+1)^2 + (z+10)^2 = 9$
   (c) $\frac{(x-1)^2}{4} - \frac{(y-2)^2}{3} + (z+1)^2 = 1$
   (d) $-\frac{(x-1)^2}{4} + \frac{(y-2)^2}{3} - (z+1)^2 = 1$
2. Write an equation of following Quadric:
   (a) Elliptic paraboloid ($C = [0;0;0]$, $a \| z$)
   (b) Hyperbolic paraboloid ($V = [0;0;0]$, $a \| z$)
   (c) Elliptic cylinder ($a \| z$)
   (d) Parabolic cylinder ($V = [0;0;0]$, $a \| z$)
   (e) Hyperbolic cylinder ($C = [0;0;0]$, $a \| z$)
3. Identify the type of a Quadric and sketch a given cut (+ write its equation)
   (a) $z = x^2 + 4y^2$ , cut for $z = 1$
   (b) $x^2 + y^2 - z^2 = 0$ , cut for $x = 0$
   (c) $x^2 - y^2 + z^2 = 0$ , cut for $z = 1$
   (d) $x^2 + y^2 = z - 1$ , cut for $y = 0$
   (e) $z^2 - x^2 - y^2 = 1$ , cut for $z = 2$
   (f) $x^2 + 4y^2 + z^2 = 4$ , cut for $z = 0$
   (g) $z^2 = y - x^2$ , cut for $y = 0$ and $x = 0$

4. Write the canonical equation of a given Quadric and identify its type:

   (a) $x^2 + y^2 + z^2 - 4x + 6y - 6z + 3 = 0$

   (b) $-4x^2 + 9y^2 + 9z^2 + 18y - 90z + 270 = 0$

   (c) $x^2 - 6x + y^2 - 16y + z^2 - 8z + 37 = 0$

   (d) $2x^2 - 8x + 3y^2 + 18y - 6z + 35 = 0$

   (e) $-3x^2 + 6x + 4y^2 - 16y + 12z^2 + 24z + 13 = 0$

5. Identify and sketch the domain $\Omega$:

   (a) $\Omega = \{[x, y] \in \mathbb{R}^2;\ x^2 + y^2 \leq 16 \quad \wedge \quad y \leq x^2 + 2\}$

   (b) $\Omega = \{[x, y] \in \mathbb{R}^2;\ \frac{x^2}{36} + \frac{y^2}{25} \leq 1 \quad \wedge \quad \frac{y^2}{4} - x^2 > 1\}$

   (c) $\Omega = \{[x, y, z] \in \mathbb{R}^3;\ z = x^2 + 4y^2 \quad \wedge \quad z = 16\}$

   (d) $\Omega = \{[x, y, z] \in \mathbb{R}^3;\ x^2 + y^2 \leq 4 \quad \wedge \quad z = 7 + x^2 + y^2\}$

   (e) $\Omega = \{[x, y, z] \in \mathbb{R}^3;\ x^2 + y^2 \leq z^2 \quad \wedge \quad z = 6 - x^2 - y^2\}$

   (f) $\Omega = \{[x, y, z] \in \mathbb{R}^3;\ 2x^2 - y^2 - z^2 = 4 \quad \wedge \quad 0 \leq x \leq 2\}$

   (g) $\Omega = \{[x, y, z] \in \mathbb{R}^3;\ z^2 \leq 10 - x^2 - y^2 \quad \wedge \quad x^2 + y^2 + z^2 = 10\}$