Course Title: **Mathematics II**   Course Code: **MA1012**

Semester: Section A, II   Maximum Marks: 12.5

Date of Examination: 22 March 2023   Time: 20 minutes

Instructions

- All questions are compulsory.

- Write legibly and show your full work to get credit.

Questions

1. Is the function $f(x, y) = 4x^2 + y^2 + 4xy$ a convex function? Justify your answer.   (**1+3 marks**)

2. What geometrical curve does $R(t) = (6\cos t, 3\sin t)$ parametrize. Justify with a diagram. (**3 marks**)

3. Show that the following limit does not exist

$$\lim_{(x_1,x_2)\to(0,0)} \frac{x_1 x_2 \cos x_2}{4x_1^2 + x_2^2}.$$

(**3 marks**)

4. What is your favourite mathematical result and why?   (**2.5 marks**)

Course Title: **Mathematics II**   Course Code: **MA1012**

Semester: Section A, II   Maximum Marks: 12.5

Date of Examination: 22 March 2023   Time: 20 minutes

Instructions

- All questions are compulsory.

- Write legibly and show your full work to get credit.

Questions

1. Is the function $f(x,y) = 2x^2 + y^2 + 4xy$ a convex function? Justify your answer.   (**1+3 marks**)

2. What geometrical curve does $R(t) = (4\cos t, 4\sin t, t)$ parametrize? Justify with a diagram.   (**3 marks**)

3. Find the following limit
$$\lim_{(a,b,c)\to(0,0,0)} \frac{1 - \cos(a + b + c)}{2ca + a^2 + b^2 + 2ab + c^2 + 2bc}.$$

      (**3 marks**)

4. What is your favourite result from last semester's linear algebra part, and why?   (**2.5 marks**)

Course Title: **Mathematics II**   Course Code: **MA1012**

Semester: Section A, II   Maximum Marks: 12.5

Date of Examination: 22 March 2023   Time: 20 minutes

Instructions

- All questions are compulsory.

- Write legibly and show your full work to get credit.

Questions

1. Mention with mathematical details one use of the Hessian of a function that was discussed in the class. (**3 marks**)

2. Is the following function differentiable at $(0,0)$? Justify your answer.

$$f(x_1, x_2) = \begin{cases} \dfrac{2x_1^2 x_2}{x_1^2 + x_2^2}, & (x_1, x_2) \neq (0,0), \\ 0, & (x, y) = (0,0). \end{cases}$$

(**1+3 marks**)

3. Show that the directional derivative of $f(a, b) = |a| + |b|$ does not exist at the point $(0,0)$. (**3 marks**)

4. How will you make the world a better place to live in? (**2.5 marks**)

Course Title: **Mathematics II**   Course Code: **MA1012**

Semester: Section A, II   Maximum Marks: 12.5

Date of Examination: 22 March 2023   Time: 20 minutes

Instructions

- All questions are compulsory.

- Write legibly and show your full work to get credit.

Questions

1. What is a convex optimization problem? Explain mathematically.   (**3 marks**)

2. When does the directional derivative of $f(a,b) = \sqrt{|ab|}$ for $(a,b) \in \mathbb{R}^2$ exists at the point $(0,0)$?   (**4 marks**)

3. Let $g(c,d) = 6 - c^2 - 4d^2$, find a vector which is perpendicular to the curve $g(c,d) = 1$ at the point $(1,1)$.   (**3 marks**)

4. Which book was referred to in the class multiple times? Mention with names of authors and publishers. (**2.5 marks**)