

**August 2014, Question 1.**

Let  $\alpha \in \mathbb{R}$ . Let  $f_\alpha: \mathbb{R}^2 \rightarrow \mathbb{R}$  be given by the formulas:

$$f_\alpha(0,0) = 0,$$
$$f_\alpha(x,y) = \frac{x^4 + y^4}{(x^2 + y^2)^\alpha}, \text{ for any } (x,y) \in \mathbb{R}^2 - \{(0,0)\}.$$

Determine, with proof, those values of  $\alpha$  for which  $f_\alpha$  is differentiable.