

科目：微積分 適用：電機系二

考生注意：  
 1. 依次序作答，只要標明題號，不必抄題。  
 2. 答案必須寫在答案卷上，否則不予計分。  
 3. 限用藍、黑色筆作答；試題須隨卷繳回。

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1. Prove: If  $f$  is the function defined by  $f(x) = \begin{cases} 2x+1, & x \leq 0 \\ x^2-x, & x > 0 \end{cases}$  then

$\lim_{x \rightarrow 0} f(x)$  does not exist. (10 points)

2. (a) Find  $\frac{dy}{dx}$  for  $y = (x^3+1)(3x^2+2x-1)$ . (10 points)

(b) Find  $\frac{d}{dt} \left( t^3 - \frac{t}{t^2-1} \right)$ . (10 points)

(c) Find  $\frac{d}{dx} \left( \frac{1-\sec x}{\tan x} \right)$ , hint:  $\sec^2 x - \tan^2 x = 1$ . (10 points)

3. The number  $\sqrt{3}$  is a root of the equation  $x^2 - 3 = 0$ . Please estimate  $\sqrt{3}$  by applying the Newton-Raphson method to the function

$f(x) = x^2 - 3$  starting at  $x_1 = 2$ . Hint: the Newton-Raphson formula is

$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$ . (10 points)

4. Find  $f$  to satisfy that  $f'(x) = 6x - 2$ ,  $f(1) = -5$ , and  $f(1) = 3$ . (10 points)

5. (a) Find  $\frac{d}{dx} \left( \int_1^{2x} \frac{dt}{1+t^2} \right)$ . (10 points)

(b) Compute  $\int x^2 e^{-x} dx$ . (10 points)

6. Given two vectors  $a = 2i + 3j + 2k$  and  $b = i + 2j - k$ . (10 points)

(a) Calculate the angle between  $a$  and  $b$ . (5 points)

(b) Find  $\text{proj}_b a$ . (5 points)

7. Find an equation  $f(x, y, z) = 0$  for the plane that passes through the

point  $P(-2, 3, 5)$  and is perpendicular to the line  $l$  with scalar parametric equations:  $x = -2 + t, y = 1 + 2t, z = 4$ . (10 points)