

**EE106 – Engineering Mathematics I**

**Problem Set 3**

Due in tutorial on Thursday, 23 October 2014

1. Differentiate the following functions:

(a)  $2x^{10} - x^7 + \frac{3}{x^{25}}$

(b)  $(x^4 + 22x^5 - 102x^2) \left(x - \frac{23}{x}\right)$

2. Find the derivatives of the following functions:

(a)  $\exp\left(e^{\cos(x)}\right)$

(b)  $3 \exp\left(\ln\left(\frac{1}{x}\right)\right)$

(Recall that  $\exp(x)$  is the same as  $e^x$ .)

3. Give the definitions of the hyperbolic functions  $\sinh(x)$  and  $\cosh(x)$ , and use them to prove the following identities:

(a)  $(\cosh(x))^2 - (\sinh(x))^2 = 1$

(b)  $2 \sinh(x) \cosh(x) = \sinh(2x)$

4. Prove that the second derivative of the product  $f(x)g(x)$  is

$$\frac{d^2}{dx^2} (f(x)g(x)) = f''(x)g(x) + 2f'(x)g'(x) + f(x)g''(x)$$