Course 2E1 2005-06 (SF Engineers & MSISS & MEMS)

S h e e t 5

Due: in the tutorial sessions next Wednesday/Thursday

Exercise 1

Use Chain Rule to express $\frac{\partial z}{\partial r}$ and $\frac{\partial z}{\partial \theta}$ as functions of r and θ in the following cases:

(i) $z = xe^y$, $x = r\cos\theta$, $y = r\sin\theta$;

(ii) $z = \frac{x}{y}$, $x = r\cos\theta$, $y = r\sin\theta$;

(iii) $z = x^2 + y^2 + u^2$, $x = r\cos\theta$, $y = r\sin\theta$, $u = r$.

Exercise 2

Find the gradient of the function:

(i) $f(x, y) = x + y^2$;

(ii) $f(x, y) = e^{x-y}$;

(ii) $f(x, y, z) = x(\cos y + \sin z)$;

Exercise 3

Find the derivative of the function f at the point P_0 in the direction of the vector $\mathbf{a}$ (i.e. in the direction of the corresponding unit vector $\mathbf{u}$):

(i) $f(x, y) = x + y, \quad P_0(1, 0), \quad \mathbf{a} = (1, -1)$;

(ii) $f(x, y) = x^2 + y^2, \quad P_0(-1, 1), \quad \mathbf{a} = (-1, 2)$;

(iii) $f(x, y, z) = 2e^x \cos(yz), \quad P_0(0, 0, 0), \quad \mathbf{a} = (1, -1, 1)$.