

Vector Calculus

Homework Set 3

Due Wednesday, 2 February 2005

Course Web Site: <http://www.math.sfu.ca/~ralfw/math252/>Textbook: **Davis and Snider** “*Introduction to Vector Analysis*”:

Reading: Sections 2.1–2.3

Problems to study (for practice; you do not need to hand these in):

- Section 2.1 (pp.70–71): 1, 2, 5
- Section 2.2 (pp.85–86): 3, 7, 12, 14
- Section 2.3 (pp.95–98): 3, 5, 8, 11, 12, 13, 16, 23

Problems to hand in:

- *Section 2.1 (pp.70–71): 3, 4*
- *Section 2.2 (pp.85–86): 2, 4, 5, 6, 8, 10*
- *Section 2.3 (pp.95–98): 7, 14, 15, 19, 21*

Please also plot the curves of problems **7** and **14** of section 2.3 using Maple. A Maple worksheet of sample commands is given on the course website, and also includes some more interesting space curves; you could have a look at these examples, and use them to motivate your own explorations. As an *additional exercise*, try to come up with your own (interesting and unique) space curve. Please print out your curves (using a perspective that clearly shows the geometry of the curves), together with the Maple commands used to generate them, clearly label your results and submit them with your assignment; also type your name in your Maple worksheet.

*Extra problem (to hand in)*1. *Curvature of Plane Curves*

- (a) Show that the curvature of a plane curve in the x - y plane, $\mathbf{R}(t) = x(t)\mathbf{i} + y(t)\mathbf{j}$, is given by

$$\kappa = \frac{|x'y'' - x''y'|}{[(x')^2 + (y')^2]^{3/2}}.$$

- (b) For the special case of a plane curve given by an explicit function of the form $y = f(x)$, show that the curvature is

$$\kappa = \frac{|y''|}{[1 + (y')^2]^{3/2}} = \frac{|d^2y/dx^2|}{[1 + (dy/dx)^2]^{3/2}}.$$

[Hint: Try a parametrization of the form $x = t$, $y = f(t)$.]