Paul's Online Notes

Chapter 3 : Parametric Equations And Polar Coordinates

In this section we will be looking at parametric equations and polar coordinates. While the two subjects don't appear to have that much in common on the surface we will see that several of the topics in polar coordinates can be done in terms of parametric equations and so in that sense they make a good match in this chapter

We will also be looking at how to do many of the standard calculus topics such as tangents and area in terms of parametric equations and polar coordinates.

Here is a list of topics that we'll be covering in this chapter.

Parametric Equations and Curves – In this section we will introduce parametric equations and parametric curves (i.e. graphs of parametric equations). We will graph several sets of parametric equations and discuss how to eliminate the parameter to get an algebraic equation which will often help with the graphing process.

Tangents with Parametric Equations – In this section we will discuss how to find the derivatives $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ for parametric curves. We will also discuss using these derivative formulas to find the tangent line for parametric curves as well as determining where a parametric curve in increasing/decreasing and concave up/concave down.

Area with Parametric Equations – In this section we will discuss how to find the area between a parametric curve and the x-axis using only the parametric equations (rather than eliminating the parameter and using standard Calculus I techniques on the resulting algebraic equation).

Arc Length with Parametric Equations – In this section we will discuss how to find the arc length of a parametric curve using only the parametric equations (rather than eliminating the parameter and using standard Calculus techniques on the resulting algebraic equation).

Surface Area with Parametric Equations – In this section we will discuss how to find the surface area of a solid obtained by rotating a parametric curve about the x or y-axis using only the parametric equations (rather than eliminating the parameter and using standard Calculus techniques on the resulting algebraic equation).

Polar Coordinates – In this section we will introduce polar coordinates an alternative coordinate system to the 'normal' Cartesian/Rectangular coordinate system. We will derive formulas to convert between polar and Cartesian coordinate systems. We will also look at many of the standard polar graphs as well as circles and some equations of lines in terms of polar coordinates.

Tangents with Polar Coordinates – In this section we will discuss how to find the derivative $\frac{dy}{dx}$ for polar curves. We will also discuss using this derivative formula to find the tangent line for polar curves using only polar coordinates (rather than converting to Cartesian coordinates and using standard Calculus techniques).

Area with Polar Coordinates – In this section we will discuss how to the area enclosed by a polar curve. The regions we look at in this section tend (although not always) to be shaped vaguely like a piece of pie or pizza and we are looking for the area of the region from the outer boundary (defined by the polar equation) and the origin/pole. We will also discuss finding the area between two polar curves.

Arc Length with Polar Coordinates – In this section we will discuss how to find the arc length of a polar curve using only polar coordinates (rather than converting to Cartesian coordinates and using standard Calculus techniques).

Surface Area with Polar Coordinates – In this section we will discuss how to find the surface area of a solid obtained by rotating a polar curve about the x or y-axis using only polar coordinates (rather than converting to Cartesian coordinates and using standard Calculus techniques).

Arc Length and Surface Area Revisited – In this section we will summarize all the arc length and surface area formulas we developed over the course of the last two chapters.

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