M233 Fall 2005 Homework 2

Due: 7 October 2005

1. Determine parametric equations for the tangent line to the curve described by $\mathbf{r}(t) = (2 - t^2)\,\mathbf{i} - (1 - t^2)\,\mathbf{j} + 5t\mathbf{k}$ at $P = (1, 0, -5)$. At what point does the tangent line intersect the plane $x + 2y + 3z = 12$?

2. Calculate the arc length of the curve parameterized by $\mathbf{r}(t) = (1 + t)^{3/2}\mathbf{i} + (1 - t)^{3/2}\mathbf{j} + t^{3/2}\mathbf{k}, \quad 0 \leq t \leq 1$.

3. Calculate the radius of curvature and the center of curvature of the curve $\mathbf{r}(t) = \sqrt{t}\mathbf{i} + (2 - t)\,\mathbf{j} + 3t\mathbf{k}$ at the point $(2, -2, 12)$.

4. Find the Cartesian equation of the osculating plane of the curve $\mathbf{r}(t) = (2 - t^2)\,\mathbf{i} + 2t^3\mathbf{j} + t^2\mathbf{k}$ at the point $(1, 2, 1)$.

5. Calculate $\mathbf{v}\,(t)$, $\mathbf{a}\,(t)$, $\kappa_{\mathbf{r}}\,(t)$, $\mathbf{T}\,(t)$, $\mathbf{N}\,(t)$, and the tangential and normal components, a_T and a_N, of acceleration for the spatial motion $\mathbf{r}(t) = (t - t^2)\mathbf{i} + (t + t^2)\mathbf{j} + t^2\mathbf{k}$.