$\mathbf{r}_u = \cos v\,\mathbf{i} + \sin v\,\mathbf{j}$, $\mathbf{r}_v = -u\sin v\,\mathbf{i} + u\cos v\,\mathbf{j} + \mathbf{k}$ $\Rightarrow$

$\mathbf{r}_u \times \mathbf{r}_v = \sin v\,\mathbf{i} - \cos v\,\mathbf{j} + u\,\mathbf{k}$ and

$\mathbf{F}(\mathbf{r}(u,v)) = u\sin v\,\mathbf{i} + u\cos v\,\mathbf{j} + v^2\,\mathbf{k}$. Then

$$\begin{aligned}\iint_S \mathbf{F}\cdot d\mathbf{S} &= \iint_D \mathbf{F}\cdot(\mathbf{r}_u\times\mathbf{r}_v)\,dA = \int_0^{3\pi}\int_0^4 (u\sin^2 v - u\cos^2 v + uv^2)\,du\,dv \\ &= \int_0^{3\pi}\int_0^4 (-u\cos 2v + uv^2)\,du\,dv = \int_0^{3\pi}\left[-8\cos 2v + 8v^2\right]dv = 72\pi^3\end{aligned}$$