

MA 229/MA 235 - Lecture 24

IISc

Recap

- Differential forms bundle.

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- Exterior derivative and its properties.

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- Closed and exact forms.

- There are two ways to integrate functions

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Iterated integrals and Fubini's theorem

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$$\int_{x^2+y^2 \leq 1} (x^2 + y^2) dA = \int_{-1}^1 \int_{-\sqrt{1-x^2}}^{\sqrt{1-x^2}} (x^2 + y^2) dy dx \quad (\text{why?})$$

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Thus it is $\int_{-1}^1 (2x^2\sqrt{1-x^2} + \frac{2}{3}(1-x^2)^{3/2}) dx$ which can be integrated (how?).

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- The problem is that if we change coordinates, then the integrals change! Heck even in \mathbb{R}^n , if f is compactly supported, if we take a smooth diffeo $T : \mathbb{R}^n \rightarrow \mathbb{R}^n$, then the integrals will not be the same. The modulus of the Jacobian kicks in.
- So the bottom line is that we cannot hope to define the integral of a *function* $f : M \rightarrow \mathbb{R}$. However, taking the dx^i seriously as 1-forms, we notice that the Jacobian factor is almost exactly how forms change under coordinate changes!
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