

MA 229/MA 235 - Lecture 21

IISc

Recap

- Tensor products.

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- Types of tensors, symmetric and alternating tensors (forms). Symmetrisation, Anti-symmetrisation.

Tensor bundles and tensor fields

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- As a consequence, a tensor field is smooth iff the coefficients in this trivialisation are smooth functions.

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- Consider “increasing” multiindices, $i_1 < i_2 < \dots$. For increasing-index-summation, we put a prime sign.
- Theorem: Increasing-index elementary forms form a basis. As a consequence, $\dim(\Lambda^k) = \binom{n}{k}$ when $k \leq n$ and 0 otherwise.
- Proof: If $k > n$, then by previous results, Λ^k is the trivial vector space (why?) So assume $k \leq n$.
- Firstly, the ϵ^I are linearly independent: If $\sum' c_I \epsilon^I = 0$, then consider $0 = \sum' c_I \epsilon^I(e_{j_1}, e_{j_2}, \dots) = \sum' c_I \delta^I_J = c_J$ (why?)
- Secondly, they span the space: Let $\alpha \in \Lambda^k$. Then let $\alpha_I = \alpha(e_{i_1}, \dots)$.

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- Secondly, they span the space: Let $\alpha \in \Lambda^k$. Then let $\alpha_I = \alpha(e_{i_1}, \dots)$. Thus $(\alpha - \sum' \alpha_I \epsilon^I)(e_{j_1}, \dots, e_{j_n}) = 0$ (why?) and

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