← TENSORS →:

Elementary properties of tensors →:

In mathematical physics tensors are introduced as generalizations of Scalars (rank 0) and vectors (rank 1) to higher dimensions, used to describe physical quantities that require multiple indices and exhibit specific transformation rules under coordinates changes.

→ Elementary properties of tensors are

1) Rank (order) →
2) Transformation properties →
3) Algebraic properties

1) Rank → (a) defination → The rank of a tensor indicates the number of indices required to describe its Components.

(b) Rank 0 → Invariant under coordinate transformation ~~~~ for example – temptature mass, etc

(c) → Rank 1 (vector) → Has one (1) index (A^i) and transformation like a vector.

(d) → Rank 2 (Matrix) → Has two indices (T_{ij}) and can be reperesented as a 2-Dimational matrix for example is stress etc.

(e) → Higher Rank → Tensors with rank 3 or higher requiring three or more indices.

<2> Transformation peroperties. →

(a) coordinate invariance – While individual tensor components (T_{ij}) change under coordinate transformations, the physical entity reperesented by the tensor remains the same.

(b) Transformation law → Components transform linearly. according to the Jacobian of the transformation

[b(i)] Contravariant Vector (A^{μ}) → Transforms with uper indices.

[b(ii)] Coveriant vector (A_{μ}) → Transforms with lower indices.

[b(iii)] Mixed ... contain both (converiand and contravariant

3. Algebric properties →

[3(a)] Addition / Subtraction → Tensors must be of the same rank and type [eg. (0,2) type] to be added or, Subtracted. The sum $C_{ij} = A_{ij} + B_{ij}$ is also a tensors.

[3(b)] – Scalar Mutiplication – A tensor multiplied by a scalar (cA_{ji}) remains a tensor of the same rank.

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