7. EINSTEIN GENERAL RELATIVITY AND GRAVITATION THEORY

The mathematics of general relativity refers to various mathematical structures and techniques that are used in studying and formulating Albert Einstein's theory of general relativity. The main tools used in this geometrical theory of gravitation are tensor fields defined on a Lorentzian manifold representing spacetime. The principle of general covariance states that the laws of physics should take the same mathematical form in all reference frames and was one of the central principles in the development of general relativity. The notion of a tensor field is of major importance in GR. For example, the geometry around a star is described by a metric tensor at each point, so at each point of the spacetime the value of the metric should be given to solve for the paths of material particles. Another example is the values of the electric and magnetic fields (given by the electromagnetic field tensor) and the metric at each point around a charged black hole to determine the motion of a charged particle in such a field. The Einstein field equations are the core of general relativity theory. These equations describe how mass and energy (as represented in the stress - energy tensor) are related to the curvature of space-time (as represented in the Einstein tensor). The Einstein field equations may be written in the form:

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4}T_{\mu\nu}$$

where $R_{\mu\nu}$ is the Ricci curvature tensor, R is the scalar curvature, $g_{\mu\nu}$ is the metric tensor, Λ is the cosmological constant, G is Newton's gravitational constant, c is the speed of light in vacuum, and $T_{\mu\nu}$ is the stress - energy tensor.

When we go to Observer's Mathematics point of view, we note immediately that "tensor idea" becomes incorrect. I.e. the idea of equality of all coordinate systems (local basises) becomes incorrect. As we proved above, tensors of type (p, q) in classical Linear Algebra are not tensors in Observer's Mathematics. They are only tensors with some probability less than 1.