What are Origami metamaterials?

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In news–Researchers from Indian Institute of Technology(IIT) Madras have developed a material that can make use of origami to reduce shock of car dashes and prevent the interiors from being damaged.

About Origami metamaterials-

- **Origami metamaterials that crumple rather than tear, and take the impact,** can play an important role in such situations.
- I**n order to be useful, materials need to maintain a constant Poisson ratio when they crumble under pressure.**
- However, they are prone not to do so, and the Poisson ratio varies as they deform.
- A **special class of materials called origami metamaterials, combine the Japanese art of paper folding (origami) and the existing material of choice and fold it to obtain desired properties.**
- The special class of **origami metamaterials developed by IIT Madras shows a constant value of Poisson Ratio when subjected to stress and they** are mechanism-based systems.
- These are **manufactured by joining panels along their edges to form 'creases'** about which the structure locally 'folds' or rotates about.
- The **benefit is that the observed property does not depend on whether it is made from a sheet of paper, polymer or metal.**
- The material the researchers have developed **has a nearly constant Poisson function in the range –0.5 to 1.2 over a finite stretch of up to 3.0 with a minimum of 1.1.**

- The **crux of the idea is a unit cell called Morph** that can transform into two contrasting geometries – One which exhibits positive Poisson ratio and the other which exhibits negative Poisson ratio.
- As per the researcher, it is possible to combine these two geometries to join and deform together as a single system, by joining them along their edges.
- When the Morph cell undergoes folding, it attains two distinct configurations that look different, but have the boundaries in such a way that they can be combined without restricting its natural folding behaviour.

What is the Poisson ratio?

- When you crush or stretch a material along a particular direction, it undergoes a modification in the perpendicular, or lateral, direction.
- **The ratio between the deformation along the force and the deformation in a direction lateral to the force is called the Poisson ratio.**
- **The Poisson ratio can be positive or negative.**
- There is a lot of interest in such materials **called auxetics.**
- **One use of auxetic materials is in lining the soles of sports shoes,** where it offers better support when running or jumping.
- If we try to crush or impact an auxetic material, it offers resistance to the crushing load as the material below will try to contract inwards, making it 'denser' and therefore, preventing the crushing load from moving further into the material.