SNS COLLEGE OF TECHNOLOGY

An Autonomous Institution
Coimbatore-35

Department of Mathematics

23MAT103 – DIFFERENTIAL EQUATIONS AND TRANSFORMS

I B.E./ B.Tech. / I SEMESTER

UNIT I : Vector Calculus

Topic : Divergence and Curl of a Vector field and Solenoidal and irrotational of a vector

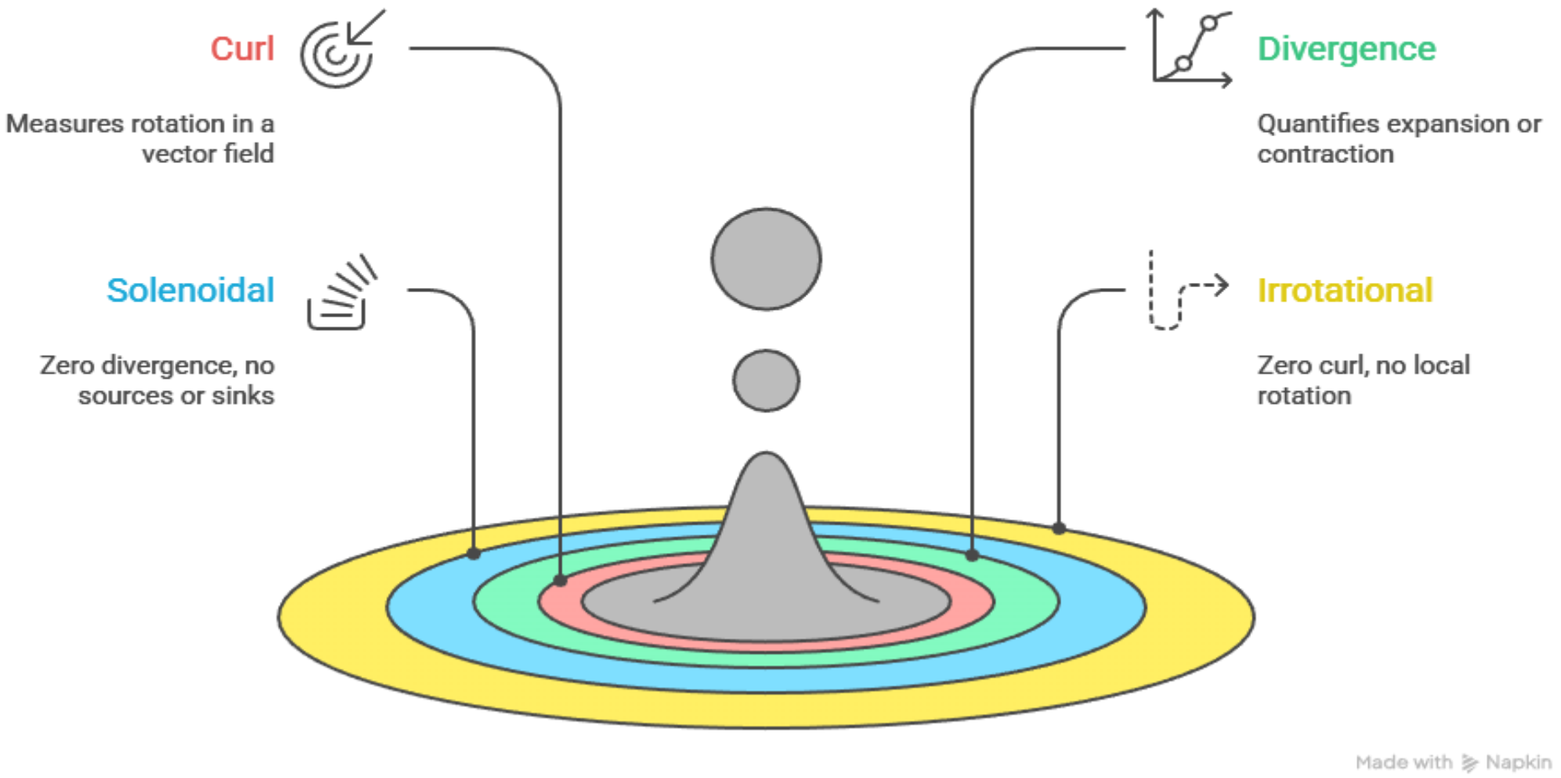
History

Joseph-Louis Lagrange (1762)

James Clerk Maxwell) (1839)

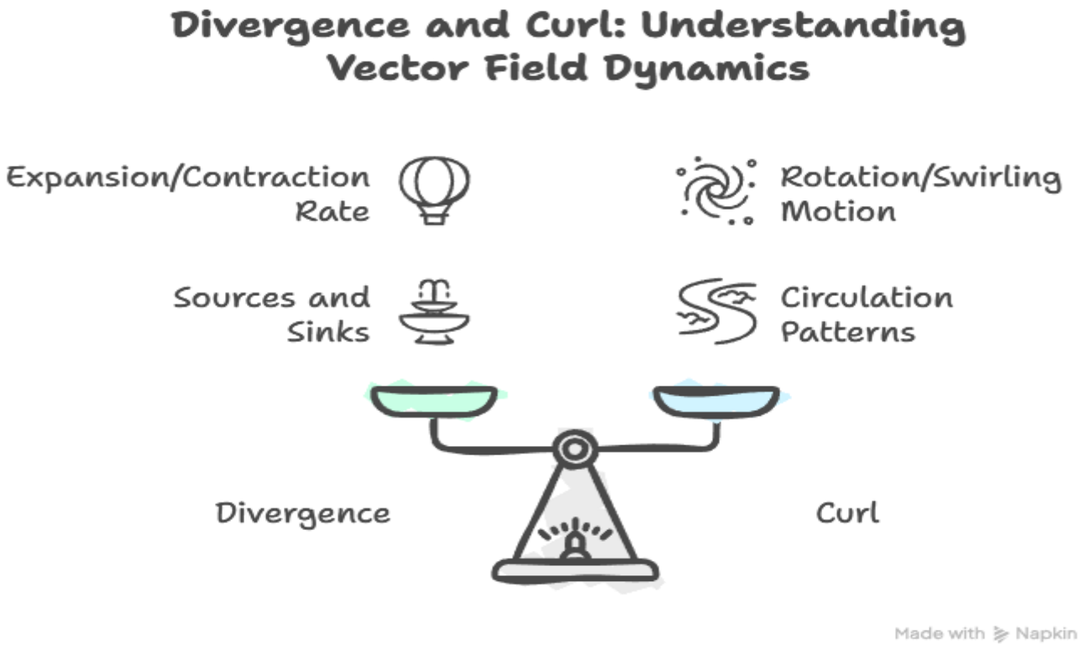
André-Marie Ampère in 1823

Vector Field Analysis

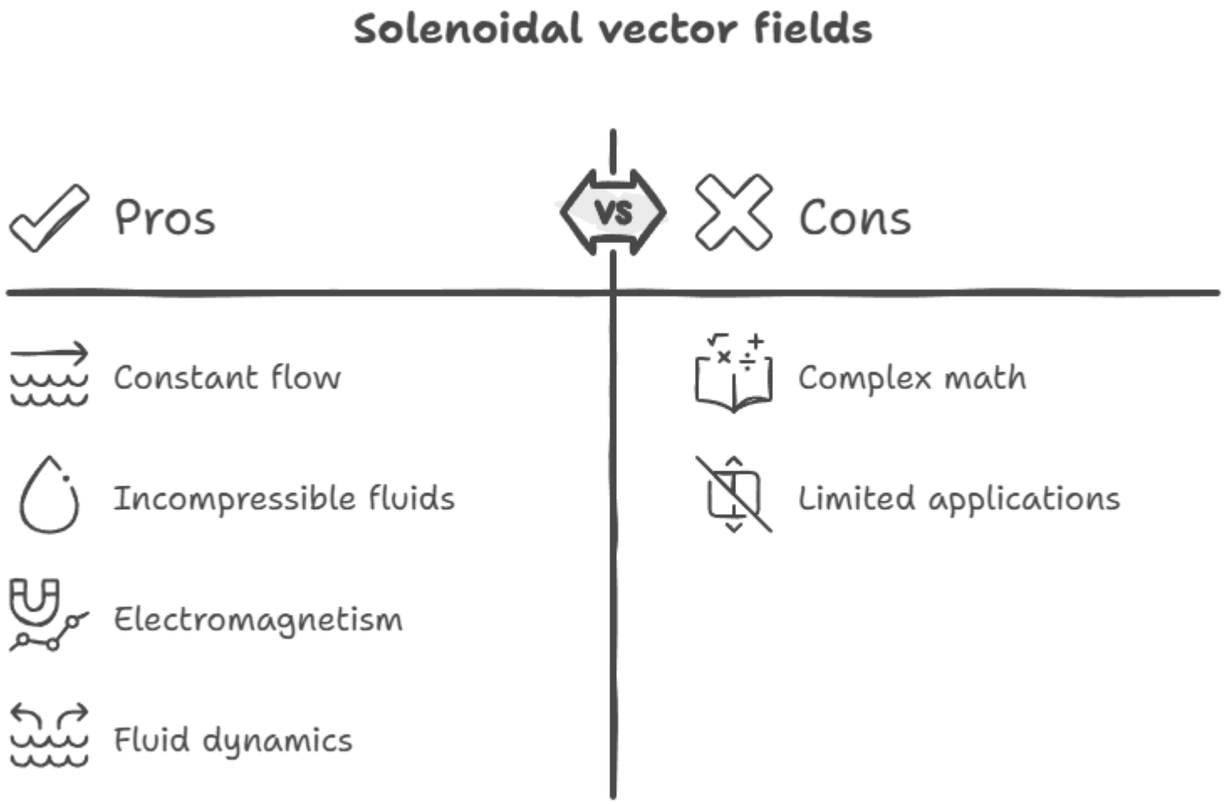


Divergence and Curl of a Vector field

Curl of a vector field is the vector obtained by taking the cross product of the del operator with the vector field.



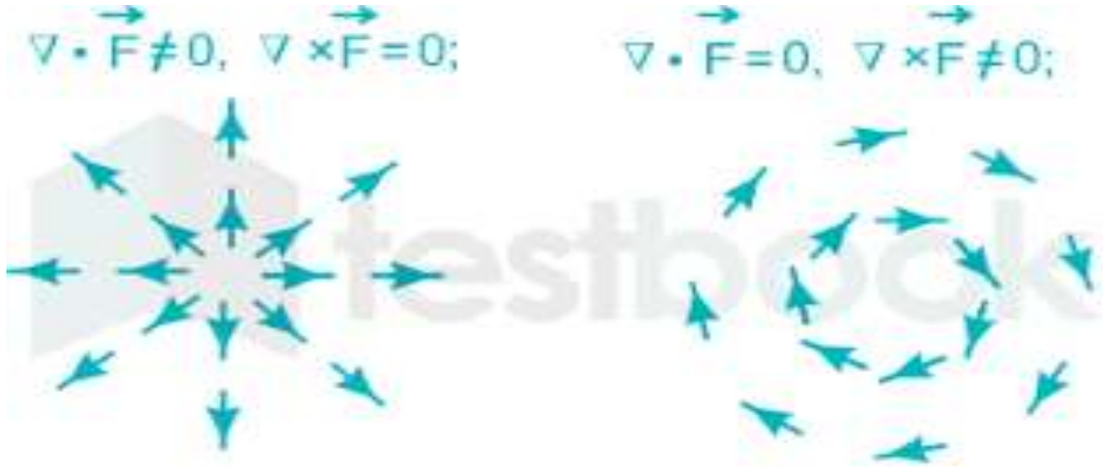
Solenoidal Vector Field



Applications

A **vector field** is said to be **solenoidal** if its **divergence is zero everywhere**.

$$\boxed{\nabla \cdot \vec{F} = 0}$$



Difference between Solenoidal and Curl

Solenoidal Vector Field

A vector field is **solenoidal** if its **divergence is zero**.

Mathematical condition: $\nabla \cdot \vec{F} = 0$

Indicates **no source or sink** in the field.

Field lines form **closed loops**.

Related to **divergence**.

Example: Magnetic field is solenoidal.

Curl of a Vector Field

Curl measures the **rotation or circulation** of a vector field.

Mathematical expression: $\nabla \times \vec{F}$

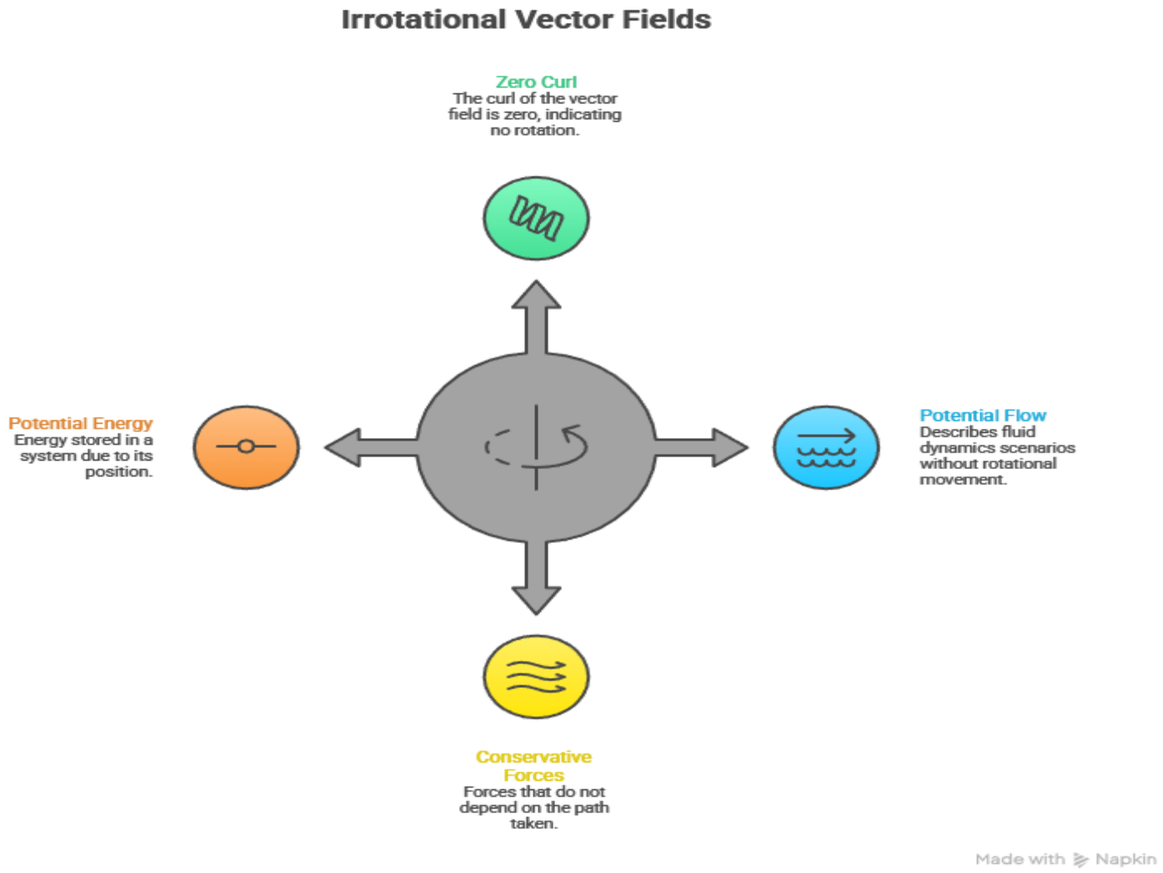
Indicates the **tendency to rotate** about a point.

Curl gives a **vector quantity** showing axis and magnitude of rotation.

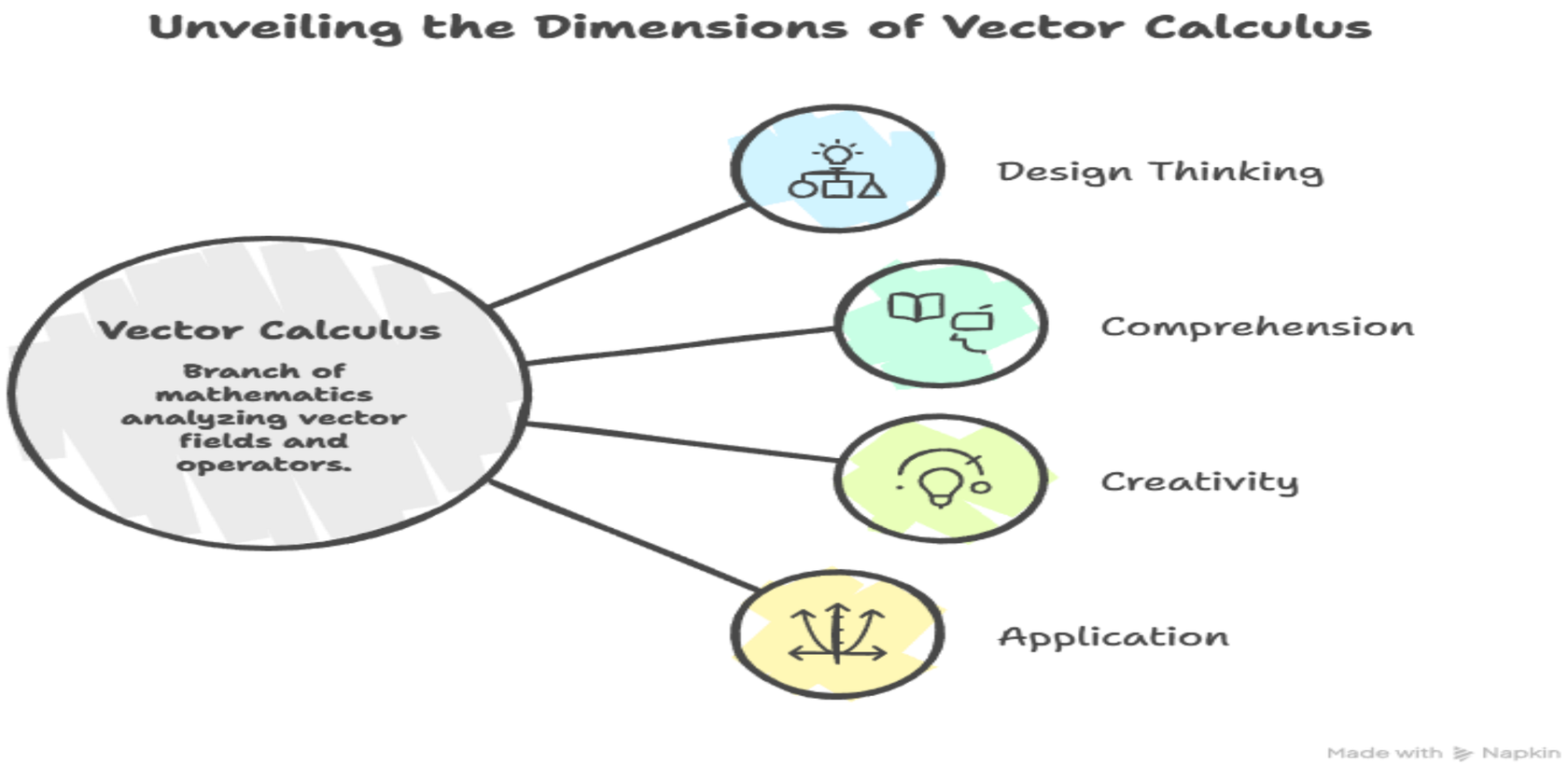
Related to **rotational nature** of the field.

Example: Velocity field of a rotating fluid has non-zero curl.

Irrotational of a vector



Vector Calculus in Design Thinking



Activity

Identify the word from the pictures given

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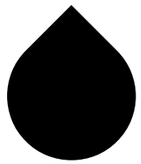

References

- https://mathinsight.org/divergence
- https://www.geeksforgeeks.org/engineering-mathematics/vector-calculus/
- https://mathinsight.org/vector_calculus


Thank you!