

Challenge Lecture Series

at IIT Hyderabad

by

Prof. A. K. Mallik

**Title: “MATHEMAGICAL BLACK
HOLES, CHAOS AND
FRACTALS”**

Venue: Lecture Hall - 3



भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology
Hyderabad

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All Are Welcome!

MATHEMAGICAL BLACK HOLES, CHAOS AND FRACTALS

Prof A.K. Mallik

Abstract

If simple arithmetical operations, starting from various integers, are repeated, then sometimes strange behaviours can be observed. For example, iterations can soon be attracted to a particular value, called mathemagical black hole (stable fixed point), independent of the starting values. Sometimes such iterations can be seen to produce a chain of particular values and thus depicting a cyclic or periodic behaviour again independent of the starting value. We will start with some examples of these kinds.

Then we will consider simple iterations carried over a range of continuous real numbers (rather than restricting to integers). Now besides black holes and periodic behaviour, another curious behaviour can be observed. Here the values, though remain bounded, never settle into a pattern, rather these wander around chaotically. When such chaotic behaviour is exhibited, a little change in the initial value gives rise to a large change in the subsequent values. During this chaotic behaviour, the iterations settle into what is called a 'strange' attractor. Over the last forty years, this realization has given rise to a new paradigm of science, known as 'Theory of Chaos', which has permeated all branches of science.

Strange attractors are known as borderline fractals which are also produced if iterations are carried over complex numbers. These fractals look self-similar at all scales. Nature is full of such fractals, for example, the coastline of a country, the borderline of clouds and snowflakes and so on. The boundaries of basins of attractors can also depict fractal behaviour. We know that point, curve, area and volume have, respectively, dimensions zero, one, two and three. Fractals will be shown to have non-integer dimensions.

Brief biography of the Speaker

Dr. A.K. Mallik is currently an Honorary Distinguished Professor and an INSA Senior Scientist at Bengal Engineering and Science University Shibpur. He was a Professor of Mechanical Engineering at the Indian Institute of Technology Kanpur 1982-2009. He is an elected fellow of Indian National Academy of Engineering (FNAE), National Academy of Sciences, Allahabad, (FNASc), Indian Academy of Sciences, Bangalore (FASc) and The Indian National Science Academy, New Delhi (FNA). He is an Honorary Fellow of The Association of Mechanisms and Machines for his life-time contribution in the field of Theory of Mechanisms and Machines. He has authored/coauthored 9 books and more than 85 research papers in International Journals. Areas of his research include Vibration Engineering, Nonlinear Dynamics and Kinematics. He also writes articles on Mathematics and Physics at popular level. He has been widely acclaimed as a speaker on popular science and mathematics, as well as in his specialized field of interest. **This talk will interest all students of engineering and science.**