# Magnetohydrodynamics in the Light of Astrophysical Dynamos' Analytic, Asymptotic and Numeric Applications

## 7-16th December 2020

## Overview

Nowadays magnetohydrodynamics are subjected in the wide range of scientific and technology applications starting from metal casting, nuclear power stations, many others and finishing with astrophysical dynamos where the greatest achievements in analytic, asymptotic and numeric approaches are reached recently. Those impressive approaches will be presented in the proposed course in the way that they could be effectively used in many other scientific and industrial applications. In this course, current/previous analytic, asymptotic and numerical methods are intended to be presented together with the results of their application to the simulation of planetary, Solar, stellar and galactic magnetic activities. We will present various analytic, asymptotic and numeric solutions explaining in details their methodical and practical usefulness for participants in the computational sciences, basic sciences, Civil engineering, Chemical engineering, Physics, Applied Mathematics, Climate, Marine, Ship crafting, Air crafting, programming and many others. This course provides training in the application of the modern astrophysical dynamos' based mathematics to a wide range of problems in various science and technology. Emphasis will be placed on the formulation of problems, on the analytical, asymptotical and numerical techniques for a solution, the computation and presentation of results. The primary objectives of the course are as follows:

- Elucidate the fundamentals of the dynamos' analytic, asymptotic and numeric applications.
- Introduce the computational methods necessary for the dynamos' numeric modeling.
- Derive the magnetohydrodynamics' induction and dynamo equations.
- Generalize magnetohydrodynamics' analytic, asymptotic and numeric approaches for using in the other scientific and industrial applications.
- Application of methods mentioned above in modeling of the planetary, Solar, stellar and galactic magnetic activities.

Participants will learn these topics through lectures and assignments. Also case studies and presentations will be shared to stimulate research motivation of participants.

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<tr><td>Modules</td><td>A: General magnetohydrodynamics and dynamo effects<br>B: Astrophysical MHD dynamo modeling<br>Number of participants for the course will be limited to fifty.</td></tr>
<tr><td>You Should Attend If your are …</td><td>▪ mathematician/ physicist/ geophysicist/astrophysicist/ engineer/research scientist.<br>▪ undergraduate or postgraduate student / researcher / faculty or scientist from technical and academic institutions / from industry interested in learning to do research on MHD and dynamo theory.<br>▪ you keen to learn how to apply mathematical methods in astro- and geophysical models.</td></tr>
<tr><td>Fees</td><td>Students from India:<br><table><tr><td>Participation without grading</td><td>Rs.1000/-</td></tr><tr><td>Participation with grading</td><td>Rs.2000/-</td></tr></table>Faculty/Scientists/Persons from Industry & Consultancy firms from India<br><table><tr><td>Faculty (Internal & External) & Scientists from R&D Labs</td><td>Rs. 4000/-</td></tr><tr><td>Persons working in Industry / Consultancy firms</td><td>Rs. 8000/-</td></tr></table>Participants from abroad<br><table><tr><td>Students</td><td>USD 100</td></tr><tr><td>Faculty/Scientists/Persons from Industry & Consultancy firms</td><td>USD 200</td></tr></table>The above fee includes all instructional materials, computer use for tutorials, free internet facility, session tea & snacks. Participants from industry / research organisations / academic institutions will be provided with twin sharing accommodation in the Institute Visitors' Block and students will be provided accommodation in Student Hostels, on payment basis, subject to the availability.</td></tr>
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# The Faculty

**Prof. Sergey V. Starchenko** is Head of Main Geomagnetic Field laboratory of IZMIRAN and Chief Investigator under the State Project “Nature, observation and modeling of the magnetic field, evolution and electrical conductivity of the deep interior of the Earth and the planets”. Besides he is the Head of the subprogram “Solar and other planetary systems" of the program of fundamental research of the Presidium of the Russian Academy of Sciences "Cosmos: studies of fundamental processes and their interrelations”. He was head of seven Russian Foundation for Basic Research’s 3-years’ grants and principal investigator in other ten. He headed two Russian Academy Programs and one Russian President grant. His major achievements in scientific leadership were heading of 2 large (each had ~$300k budget for 10 institutions) INTAS grants in 1999-2002 and 2004-2007. He works in many scientific journals and funds as expert and referee. His research interests include magnetism and hydrodynamics in the Earth, planets, stars, galaxies and other objects. His main specialization is analytic and asymptotic modeling of convection and magnetism in fast rotating shells.

**Dr. HP Rani**, Associate Professor of Mathematics from NIT Warangal is an academician and researcher. She did her post doc in National Taiwan University, Taiwan and worked as a research professor in Kyung Hee University, South Korea. She has introduced a new concept of boundary layer flow visualisation through heatlines and masslines, Energy streamlines and Field Synergy. Her work in flow assisted corrosion problems has gained currency in the nuclear industry. The detailed analysis of microcirculatory blood flow in the hepatic lobule has got much appreciation from the medical community. Her area of interest includes finite difference and finite volume methods with the applications in heat and mass transfer, biomechanics, flow assisted corrosion, magnetohydrodynamics and geodynamo problems. She has contributed her knowledge in CFD in the field of geophysics and astrophysical fluid dynamics, by publications and by delivering lectures in Indian Institute of Geomagnetism.


# Course Co-ordinator

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