Nonlinear Dynamics of Classical Magnetic Systems

Course Dates: 10-11-2017 to 09-12-2017

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Overview

The balance between injection and dissipation of a physical quantity leads a system to behave in a complicated manner, producing a rich variety of spatiotemporal structures. Commonly, systems far from equilibrium are described by nonlinear differential equations (NDEs) or coupled maps. In general, it is not possible to obtain analytic solutions for these NDEs. Nevertheless, in the last decades an extensive variety of general techniques have been developed to obtain approximate solutions close to the onset of the instabilities. In a determinist system, different type of states can be found varying the parameters and the initial conditions. By changing one parameter in the system, it can pass from one state to another. For instance, in an extended system a homogeneous state can become a pattern. This type of bifurcation is called spatial instability. The pattern can be regular or chaotic. The latter term means that pattern's behavior in a long time window is aperiodic and sensible to the initial conditions. One type of physical systems that presents a variety of complex phenomena is the magnetic systems, especially when a parametric driven forcing is acting over the system. In fact, in low dimensional magnetic system chaotic behaviors may appear when the magnetic field is a time dependent function. On the hand, extended systems can exhibit dissipative Solitons or Faraday waves depending on the amplitude and frequency of the driven forcing.

The course pretends to cover problems concerning systems far from equilibrium where there is a competition between injection and dissipation of energy. The prototypes models will be based on contemporary magnetic systems at nanometer scales. Theoretical and numerical approaches will be treated. These problems are interesting from both physical and mathematical point of view. The first goal of the course is to motivate students to solve complex problems. The course will focus on different aspect of parametric instabilities in magnetic systems, at zero-, one- and two- spatial dimensions. The different types of dimensions have a practical significance because they can be used to model particles, wires, stripes as well as spin-valve oscillator devices, which are central part of nanoscience and have potential technological applications. The second goal is to show the intrinsic correspondence between the physics and mathematics of the magnetic systems. The derivation of the spatiotemporal evolution equations will be performed and some features of them will be analyzed. The final goal is to show how several branches of mathematics are indispensable to characterize the dynamical behavior of such systems. In particular, different methods based on bifurcation analysis, perturbation methods, and the normal form theory will be introduced. In addition, numerical simulations techniques will be examined. In particular, the Lyapunov exponents method will be shown.

The course will benefit the students of graduate and post graduate levels, and academicians of mathematics and physics to acquire a new experience to apply mathematical methods in modern physical problems.

Modules	Foundations of magnetism, Magnetization dynamics , Non-autonomous dynamics , Simulations Conservative systems, 1D, 2D systems out of equilibrium, Spintronics
You Should Attend If you are…	▪ practicing engineer or research scientist interested in solving multidiscipline problems ▪ B. Tech./ B.Sc/M.Tech./M.Sc/Ph.D. student interested in study or research in solving coupled problems. ▪ faculty members from academic institutions involved in teaching and research on computational mechanics.
Fees	Faculty: Rs. 4,000/-; Participants from Industry / Research Organizations: Rs. 8,000/- Students & Research Scholars: • Without award of Grade : Rs.2,500/-; • With award of Grade: Rs.2,000/- Students from abroad: $ 100; Other Participants from abroad: $ 200 The above registration fee includes all instructional materials, computer use for tutorials and assignments and 24hr free internet facility. The participants will be provided Boarding and lodging on payment basis. Travelling allowance will not be provided.

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<tr><td>REGISTRATION PROCESS:</td><td>Stage-1: Web Portal Registration
Visit http://www.gian.iitkgp.ac.in/GREGN/index and create login User ID and Password. Fill up the registration form and do web registration by paying Rs. 500/- online through Net Banking/Debit/Credit card. This provides the user with life time registration to enroll in any number of GIAN courses offered. (If you have already registered in GIAN portal you can skip this step.)

Stage-2: Course Registration:
Login to the GiAN portal with the user ID and Password already created in Step 1. Click on Course Registration option at the top of Registration form. Select the course titled “Nonlinear Dynamics of Classical Magnetic Systems” from the list and click on Save option. Confirm your registration by clicking on Confirm Course.</td></tr>
<tr><td>SELECTION AND MODE OF PAYMENT:</td><td>Candidates registering early will be given preference in short listing process. Selected candidates will be intimated through E-Mail. They have to remit the necessary course fee to the Bank as per the details given below.
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The Faculty

Dr. David Laroze is the Professor at the Institute for Advanced Studies at the University of Tarapacá (Chile). He is the Director of the Mathematical Modeling Laboratory at the University of Tarapacá. Previously, he was a Research Associate at the Physics and Astronomy School at the University of Glasgow, United Kingdom; a Postdoctoral Researcher at the Max Planck Institute for Polymer Research, Germany; Postdoctoral Researcher at the University of Chile, Chile and Assistant Professor at the Pontifical Catholic University of Valparaiso, Chile. His research interest includes nonlinear phenomena, pattern formation, hydrodynamic instabilities, thermal convection, magnetism, chaos theory, numerical method, cardiac dynamics, radiation problems and thermal and electronic transport in quantum systems. He has published more than one hundred manuscripts in journals and conference proceedings, including 82 papers in journals indexed in the Web of Science – Journal Citation Reports such as Scientific Reports, to name a few: Macromolecules, Physical Review B, Physical Review E, Nanotechnology, Plos One, J. Chemical Physics,EPL, Journal of Applied Physics, J. of Magnetism and Magnetic Materials, Semiconductor Science and Technology, Photochemical and Photobiological Sciences, and Atmospheric Research. He has been invited around the world as invited speaker and visiting researcher in several Universities and Research Centers.

Dr.Y.Rameshwar is working as an Assistant Professor in the Department of Mathematics, University College of Engineering, Osmania University. He visited Comenius university, Slovakia thrice as a visiting guest to do research work on Geophysical Models. He did collaborate research work (Research Associate) on chaotic dynamics with Prof.M.K.Verma, IIT Kanpur. He published his research work in Int. J. Heat and Mass Trans, J. Physical Society of Japan, Meccanica, Astrophysics space science journal, ASME J. Heat Transfer etc. His areas of research includes: Hydrodynamics and Hydromagnetic Stability, Ferrohydrodynamics, Pattern Formation, Solitons.

Dr. P. Ramesh Babu is currently working as Professor of Mechanical Engineering at University College of Engineering, Osmania University. He has rendered more than 19 years of professional service. His teaching and research interests are in Design and Manufacturing. The topics include Theoretical and Experimental Stress Analysis, Fracture Mechanics, FEM in Engineering, Composites and Smart Structures. Some his work published in ASME Transactions, Composite Structures, Composites Part-A, Composite Science and Technology, JAST, JRPC etc. He is a Life member of several professional societies like ASME, MIE, ISTE etc. He has been quite often associated as advisor and expert to various Government and R&D departments such as BDL, CITD, AICTE, UGC, APPSC, ASL, RCI and DRDL etc.

Course Co-ordinators

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