IISER Pune - Course Content

Semester	AUG 2025
Open to Semester	5,7,13,21,9
Course Code	PH4273
Course title	Non-linear Dynamics
Nature of Course	LE - Lecture
Credit	3
Coordinator and participating faculty (if any)	**Dr. T. S. Mahesh**
Pre-requisites	Calculus and Mathematical Methods in Physics
Objectives	This is the first course on the foundations of nonlinear dynamics. It caters to students from physics, mathematics, biology, chemistry and earth sciences. Hence, this course attempts to introduce core ideas of nonlinear dynamics and applications without getting too much into formal proofs. This is useful for students interested in introductory ideas for nonlinear dynamics and complex systems.
Course content	Part – 1 (8 Lectures) Basics: Linear and Nonlinear Dynamical systems 1. Linear and nonlinear systems in one dimension 2. Stability and bifurcations in one-dimension 3. Flows on a circle. 4. Linear and nonlinear systems in two-dimensions 5. Limit cycles and Poincare-Bendixon theorem 6. Bifurcations in two-dimensions Part – 2 Chaotic Dynamics (10 Lectures) 7. Symbolic sequences 8. Chaos in one-dimensional maps 9. Measures of chaos 10. Bifurcation cascades and Feigenbaum universality, scaling 11. Routes to chaos 12. Characterization of chaos Part – 3 Measuring chaos and associated phenomena (5 Lectures) 13. Fractals and strange attractors 14. Dimensions and entropies 15. Multifractals 16. Applications to real systems

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	Part – 5 Introduction to Advanced Topics (4 Lectures) 17. Pattern formation and spatiotemporal dynamics 18. Integrability and solitons 19. Complex Dynamical networks
Evaluation / Assessment	End-Sem Examination-40% Mid-Sem Examination-30% Others-Quizzes, Assignments (30 %)
Suggested readings	1. Nonlinear Dynamics and Chaos, Steven Strogatz (Pegasus Books). 2. Chaos in dynamical systems, Edward Ott, (Cambridge University Press, 2003). 3. H. G. Schuster, Deterministic Chaos, Verlag, Weintein, 1998. 4. H. O. Peitgen, P. H. Richter, The Beauty of Fractals, Springer, Berlin, 1986 5. M. Lakshmanan and S. Rajasekar, Nonlinear Dynamics: Integrability, Chaos and Patterns, Springer - Verlag, Berlin, 2003. 6. Chaos : An introduction to dynamical systems, K. T. Alligood, T. D. Sauer and J. A. Yorke (Springer, 1996)
When Next	Jan -2026
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