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| Semester | JAN 2023 |
| Open to semester | 8,14,22 |
| Course code | **PH4273/PH6423** |
| Course title | **Non-linear Dynamics** |
| Credits | 3 /3 |
| Course Coordinator & participating faculty (if any) | M. S. Santhanam |
| Nature of Course | Lectures |
| Pre-requisites | Calculus and Mathematical methods is preferred. |
| Objectives (goals, type of students for whom useful, outcome etc) | This is a 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<br>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 contents (details of topics /sections with no. of lectures for each) | Part – 1 (7 Lectures)<br>Basics : Dynamical systems way of doing things<br>1. Linear and nonlinear systems in one dimension<br>2. Stability and bifurcations in one-dimension<br>3. Flows on a circle.<br>4. Linear and nonlinear systems in two-dimensions<br>5. Limit cycles and Poincare-Bendixon theorem<br>6. Bifurcations in two-dimensions<br><br>Part – 2 Chaotic Dynamics (9 Lectures)<br>7. Symbolic sequences<br>8. Chaos in one-dimensional maps<br>9. Measures of chaos<br>10. Bifurcation cascades and Feigenbaum universality, scaling<br>11. Routes to chaos<br><br>Part – 3 Measuring chaos and associated phenomena (4 Lectures)<br>12. Chaos in flows<br>13. Fractals and strange attractors |

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| | 14. Dimensions and entropies<br>15. Multifractals<br><br>Part – 4 Hamiltonian chaos (4 Lectures)<br>16. Hamiltonian chaos<br>17. Smale Horseshoe map<br>18. Applications to real systems<br><br>Part – 5 Introduction to advanced topics (4 Lectures)<br>19. Pattern formation and spatio-temporal chaos<br>20. Integrability and solitons<br>21. Quantum chaos<br>22. Complex networks |
| Evaluation /assessment | End-Sem Examination-40%<br>Mid-Sem Examination-30%<br>Others-2-3 class tests ( 30 %)% |
| Suggested readings (with full list of authors, publisher, year, edn etc.) | 1) Nonlinear Dynamics and Chaos, Steven Strogatz (Pegasus Books)<br><br>2) Chaos : An introduction to dynamical systems, K. T. Alligood, T. D. Sauer and J. A. Yorke (Springer, 1996)<br><br>3) Chaos in dynamical systems, Edward Ott, (Cambridge Univ Press, 2003). |