Course Title	**Dynamical Systems**	Course No.	SS321
Focus Group	Systems Science	L-T-P[C]	3-1-0[4]
Offered for		Type	Compulsory for SS
Pre-requisite		To take effect from	July 20, 2014

Objectives:

1. To introduce the concept of linear and nonlinear dynamical systems.
2. To learn the basic ideas and methods associated with dynamical systems, like, evolution of system, fixed points, periodic points, attractors, bifurcation process and stability of the systems.
3. To understand the nonlinearity in nature and study of the nonlinear models in engineering and its dynamics.
4. Use Matlab and simulink for solving dissipative dynamical systems which are more relevant to the engineering problems.

Learning Outcomes:

1. Construction of phase portraits of nonlinear system and understanding of fundamental difference between linear and nonlinear systems.
2. Identification of fixed points, periodic points and limits cycles and determine their stability.
3. Elementary bifurcations like, saddle node, period doubling etc.
4. Concept of attractors, chaotic attractors; measurement of chaos and its application to various engineering models.

Contents:

History of Dynamics, The importance of being Nonlinear, A Dynamical view of the world, Examp of dynamical systems. Uncoupled Linear systems, Diagonalization, Exponential of operators, Linear systems in R^2 and Stability theory, Nonhomogeneous Linear systems. Nonlinear differential equations, Vector field of nonlinear systems, Phase portrait. Limit cycles and their stability.

Logistic maps, period doubling bifurcations, Flip and tangent bifurcations, Periodic windows, Intermittency transcritical, Liapunov exponent, Universality and Experiments, Renormalization, Cantor Set, Two dimensional maps, Bifurcation in two-dimensional maps.

Lorenz equations, Rossler Equation, Chuas circuit, Forced pendulum. Stable and Unstable manifolds, Basin boundary, Horseshoe maps, Boundary crisis, Interior crisis, Statistics of Chaotic attractor, Frequency spectra of orbits, Matrix times circle, Dynamics on a Torus, Analysis of a chaotic Time series, Lyapunov function and Central Manifold theory, Non-smooth bifurcations, bifurcation in piecewise smooth 2-dim map, multiple attractor bifurcation, and control of chaos.

Lab Module: Use Matlab/ Mathematica software to simulate and study dynamical systems in one and two dimensions. A course project related to the study of system, modeling, simulation of mathematical model using software and device simulation using Matlab.

Reference Books:

1. Steaven Strogatz, Nonlinear dynamics and chaos, Levant Books (Indian Edition) 2007, First Edition .
2. K. Alligood, T. Sauer and J. Yorke, Chaos: An Introduction to Dynamical systems, Springer, 2008, 2nd Edition.
3. Robert L Devaney, An Introduction to Chaotic Dynamical Systems, Addison Wesley.