IV B.Tech – I Semester
(20EE7649) NONLINEAR DYNAMICS FOR POWER ELECTRONIC CIRCUITS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	4	-	-	4

Pre-Requisite: Power Electronics, Control Systems

Course Objectives

1. To understand the nonlinear behaviour of power electronic converters.
2. To understand the techniques for investigation on nonlinear behaviour of power electronic converters.
3. To analyse the nonlinear phenomena in DC-to-DC converters.
4. To analyse the nonlinear phenomena in AC and DC Drives.
5. To introduce the control techniques for control of nonlinear behaviour in power electronic systems.

Syllabus

Unit – 1: Basics of Nonlinear Dynamics

System, state and state space model, Vector field- Modelling of Linear, nonlinear and Linearized systems, Attractors, chaos, Poincare map, Dynamics of Discrete time system, Lyapunov Exponent, Bifurcations, Bifurcations of smooth map, Bifurcations in piece wise smooth maps, border crossing and border collision bifurcation.

Unit – 2: Techniques for Investigation of Nonlinear Phenomena

Techniques for experimental investigation, Techniques for numerical investigation, Computation of averages under chaos, Computations of spectral peaks, Computation of the bifurcation and analysing stability.

Unit – 3: Nonlinear Phenomena in DC – DC Converters

Border collision in the Current Mode controlled Boost Converter, Bifurcation and chaos in the Voltage controlled Buck Converter with latch, Bifurcation and chaos in the Voltage controlled Buck Converter without latch, Bifurcation and chaos in Cuk Converter. Nonlinear phenomenon in the inverter under tolerance band control

Unit – 4: Nonlinear Phenomena in Drives

Nonlinear Phenomenon in Current controlled and voltage-controlled DC Drives, Nonlinear Phenomenon in PMSM Drives.

Unit – 5: Control of Chaos

Hysteresis control, sliding mode and switching surface control, OGY Method, Pyragas method, Time Delay control. Application of the techniques to the Power electronics circuit and drives.

Course Outcomes

S. No	Course Outcomes	BTL
1.	Ability to understand, model and simulate chaotic behaviour in power electronic systems.	L3
2.	Ability to investigate the various techniques of nonlinear phenomena.	L4
3.	Ability to analyse the nonlinear phenomena in DC-DC converter.	L4
4.	Ability to analyse the nonlinear phenomena in Drives.	L4

Correlation of COs with POs& PSOs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	2	2		1					2		1	1	2	1
CO 2	2	2							2		1		1	1
CO 3	2	3	1						2				3	2
CO 4	2	2							2		1			2

1 – Weak, 2 – Moderate and 3 - Strong

Text Books:

1. George C. Vargheese, July 2001 Wiley – IEEE Press S Banerjee, Nonlinear Phenomenon Power Electronics, IEEE Press.
2. Steven H Strogatz, Nonlinear Dynamics and Chaos, Westview Press.
3. C.K.TSE Complex Behaviour of Switching Power Converters, CRC Press, 2003.
4. Alfredo Medio, Marji Lines, "Non-Linear Dynamics: A primer", Cambridge University Press, 2003.

Reference Books:

1. Soumitro Banerjee, George C. Verghese "Nonlinear Phenomena in Power Electronics: Bifurcations, Chaos, Control, and Applications", Wiley, 2001.
2. Thomas L. Carroll, Louis M. Pecora, "Nonlinear Dynamics in Circuits", World Scientific Publishing Co. Pte. Ltd., 1995.
3. Visarath In, Patrick Longhini, Antonio Palacios, "Applications of Nonlinear Dynamics: Model and Design of Complex Systems", Springer – Verlag Berlin Heidelberg 2009.
4. Guanrong Chen, Tetsushi Ueta, "Chaos in Circuits and Systems", Series B, Vol. 11, Scientific Publishing Co. Pte. Ltd., 2002.