S.p.36. AMBIKA, G.–Studies on the universal parameters and onset of chaos in dissipative system–1988–Dr. K. Babu Joseph.

The thesis work is mainly centered on the asymptotic behaviour of nonlineal nonintegrable dissipative dynamical systems. It is found that such systems exhibit random behaviour or chaos. The nature of the onset of chaos and the statistical description of the chaotic state are fascinating fields of study. One of the

mechanisms for onset of chaos in many systems is the period doubling bifurcations. This route to chaos is characterised by a universal behaviour described by two universal indices viz. the bifurcation rate and the scaling factor α as well as the universal function g(x). These are usually computed numerically.

The thesis reports a new analytic algorithm developed using a perturbative scheme to computeα, and g (x) for general one hump maps of the form $x_{n+1} = 1 - a \times n^z$ where z is the order of the local maximum. For a given z, it is possible to carry out the calculations to any order of accuracy. However the perturbative series is not highly convergent but asymptotic in nature and so the use of Pade approximants is found to give reliable results. When z is not an integer, but $z = z' \pm \epsilon$ with z' the integer nearest to z, the expressions for α and can be expanded in powers of E + vc.....

At the accumulation point of the bifurcations a_∞, the iterates of g(x) form a nearly self-similar Cantor set. The first three dimensions D_0, D_1, D_2 of this set are computed using our method and their variation with z is studied.

The latter part of the thesis deals with investigations on the onset of chaotic behaviour in a driven pendulam with van der Pol like dissipation. We apply Melnikov criterion to predict the onset of chaos in this system, followed by a detailed numerical analysis. We observe that at low frequencies, the system has a strange attractor while at medium frequencies, the limit cycle develops a stochastic band. Inside the band, subharmonic bifurcations can be observed. The effect of an additive white noise in this system is to wash out the random nature to some extent, although the approach to chaos is accelerated by noise.