JPG To PDF - Unregistered
If you want to remove this text, Please register

JPG To PDF - Unregistered
If you want to remove this text, Please register

JPG To PDF - Unregistered
If you want to remove this text, Please register

Basrah J. Science, A, Vol.16, No.2, 7-12, 1998

CHAOS IN SIMPLE HARMONIC DAMPED EXTERNALLY DRIVEN OSCILLATOR

A.A. Amarah, C.A. Emshary and H.A. Badren
Department of Physics, College of Education,
University of Basrah, Basrah, IRAQ.

ABSTRACT: We have shown that simple harmonic damped externally driven (SHDED) oscillator can possess many of dynamical modes. There exist a wide domain of *damping factor*, *external force* and its *angular frequency* within which periodic, multiperiodic and chaotic motions happen to occur.

1. INTRODUCTION

Since 1963, interest in irregular behavior of nonlinear dynamical systems has grown exponentially[1]. The existance of "stable" aperiodic solutions in apparently simple deterministic systems sharply conflicts with the expectations that have developed from studies of linear physical systems.

The conventional training suggests to us that irregularity appears only in complicated transients which die out. The persistence of irregularity is not anomalous but also conflicts with many of the concepts about the order and regularity of the deterministic processes in nature. Even more remarkable has been the discovery that deterministic systems not necessarily predictable ones.

We must now come to the more sophesticated recognition that irregularity and unpredictability are not just connected with random processes, but they may arise from deterministic situations.

A deterministic system is one for which there are equations of motions which can be used together with a precise description of the present conditions to know exactly its evolution in time, forward and backward.

One might suspect that an isolated single-pendulum system would have no interesting dynamical properties. If the pendulum is rigbid this is true. An isolated rigid single pendulum is an integrable system, with a periodic one-dimensional orbit making up its one-dimensional constant-energy phase-space trajectory. But the problem becomes interesting as soon as another degree of freedom is added. Adding one more degree of freedom expands the accessible constant phase-space region to three dimensions and makes chaotic motion at least possible[2-6]. The additional degree of freedom can come from relaxing the rigidity constant, from adding another mass, from making the pendulum spherical and adding a constraint, or from external driving. Any of these four sources can lead to chaos.

The system to be studied in this paper is a simple harmonic damped and forced oscillator.

2. MATHEMATICS

The well known equation of motion of SHDED is

$$m\ddot{x} + b\dot{x} + kx = F\cos(wt) \qquad \text{.....(1)}$$

Where m is the mass of the oscillator, x, $\dot{x}$, $\ddot{x}$ are the distance, velocity, and 2nd derivative of distance. K is the force constant, b is the damping factor, F is external force amplitude and w its