Noise affects most of the activities. The term noise is used to describe fluctuations about the mean deterministic stationary value of a physical quantity. Noise is generally associated, for example, with inaccuracies in measurements or impurities in signals such as musical notes and hence is undesirable. However, its essential role in physical processes was pointed out in the beginning the last century by Smoluchowski and others. It is only in the last two decades or so that the positive (active) aspects of its role has come to light and is being subjected to intense scrutiny. It is now being increasingly realised that noise is an important ingredient to bring order in dynamical processes. Though it appears counterintuitive, noise seems to help in directing transport processes in biological systems at the molecular level.

Introduction

Real systems, be they physical or biological, are not isolated from the external world. These systems are, therefore, always subjected to disturbances – a measurement of any physical quantity exhibits fluctuations. Though one would always prefer a fluctuation-free (noise-free) measurement, it is impossible to avoid these nuisances altogether because of the inherent discrete and open nature of real systems. These little fluctuations about a steady, tranquil, (local, global or temporal) equilibrium condition, however, provide valuable information about the system (via fluctuation-dissipation relations). Also, the fluctuations are often the precursor of a change to
a new state when a system is driven away from equilibrium. In addition, as will be discussed in this article, there are experimentally observed phenomena wherein the fluctuations (noise) aid certain physical processes constructively. Thus, contrary to the general belief of noise being a nuisance it is capable of playing a positive role in physical, chemistry as well as in biology. We list below a few interesting and currently popular examples.

(1) The study of time evolution of a spatially distributed system subjected to multiplicative noise (state dependent fluctuating forces, for example fluctuating forces that are explicitly dependent on spatial coordinates [and hence could also be correlated in space] as opposed to additive noise which are uniform in space) shows surprising behaviour: Noise can generate an ordered state through a genuine phase transition (in a thermodynamic sense). For example, when fluctuations increases order is enhanced, such as noise-induced spatial patterns, noise-sustained waves, fronts, etc. (2) Stochastic resonance: A phenomenon where noise proves to be an important useful ingredient for the selection of (weak) signals and their transmission. See Box 1 for a brief introduction. (3) Noise can also help in stabilizing or slowing down the decay of an unstable state. This phenomenon is known in the literature as noise-induced stability. And (4) the net unidirectional motion of a Brownian particle in a periodic potential system without the application of any obvious bias. This phenomenon is popularly known in the current literature as the *ratchet* effect. In the rest of our discussion we shall confine ourselves to the ratchet problem only.

Though the subject is not new, the study of transport in periodic potentials has received considerable attention during the last few years. Many physical models have been proposed to obtain net unidirectional (macroscopic) currents. In these models no obvious external bias (e.g., electrical, chemical or temperature gradient)