SUMMARY

In this first chapter we focus our attention on some results involving the site percolation problem. Typically, data on the lattice percolation problem are given for the nearest neighbour or the next nearest neighbour sites. However, long range interactions may play a significant role, when quantum effects such as tunnelling are encountered. Tunnelling of triplet excitons can account for the low percolation concentration threshold detected in substitutionally disordered molecular crystals. Similarly, electrical conductivity of highly doped semiconductors has been viewed as long-range percolation process.

In this second chapter we discuss about Random walking & anomalous diffusion on regular lattices, such as Levy walks and Levy flights and we introduce diffusion on scale- free and random networks.

In the third chapter we derive an exact formula for information dimension D_I for random – walk processes in terms of the V(r,n) function ,the function that gives the number of sites that have exactly r visits during a random walk on a lattice after n steps. This form is general ,and it pertains both to regular lattices and fractal structures .The controlling parameter is S_n ,the number of sites visited at least once in an n – step walk. We perform computer simulations on regular lattices and on fractal structures : the Sierpinski gasket the Sierpinski carpet, two dimensional and three dimensional percolation clusters exacly at criticality, It is found that D_I has the same numerical value as the spectral dimension as $n \rightarrow \infty$, but it takes unusually long times to reach such behaviour.

In the fourth chapter the scaling exponent for the mean square distance covered in a random walk (*dw*) and the average number of distinct sites visited (*dn*) are determined for a family of Sierpinski carpet patterns. We suggest a new random walk algorithm to generate walks on an effectively infinite deterministic fractal lattice. The algorithm is applied to several Sierpinski carpet patterns with the same Hausdorff dimension. We show that the systems have a quite different scaling exponent *dw* and, further, that the generally accepted result *dn* = *ds* does not hold for all of these, where *ds* is the spectral dimension.

In the fifth chapter we study the behavior of non linear pattern of two dimensional reactions Lattice Lotka – Voltera through Monte Carlo simulation in two dimensional substrates. During the evolution of the system on the lattice, phenomena of spontaneous cluster formation emerge which appear to have fractal structure and theirs concentration perform oscillations by time. This structure is studied with the use of d_f (box-counting technique) .The modification in the behaviour of the dynamic system with the introduction of fractal substrates is also studied .It seems that the regulation of the fractal dimension can predefine the course of the reaction leading even to the poisoning of the substrate with one of the two reactants. Finally the reverse model is being studied as well as the effect of mixing in the structure of the system.

Finally, we study the hull of the territory visited by N random walkers after t time steps. The walkers move on two-dimensional substrates, starting all from the same position. For the substrate, we consider (a) a square lattice and (b) a percolation cluster at criticality. We perform numerical simulations for the those processes and find that the structure of the hull is self-similar and described by a fractal dimension d_H that slowly approaches, with an increasing number of time steps, the value $d_H = 4/3$.