CHAPTER I

INTRODUCTION

The discovery of recoilless emission and resonant absorption of gamma rays by nuclei rigidly bound in solids, by Rudolf L. Mössbauer in 1958, led to the development of an elegant technique for the experimental observation of transitions between the nuclear energy levels. There exists a wide range of phenomena which gives rise to small changes in the nuclear transition energies via the hyperfine interactions between a nucleus and its surrounding electrons. The practical utility and potency of the Mössbauer effect technique lies in the fact that extremely small fractional changes of the transition energies of the order of 10^{-10} to 10^{-4} can be measured. Since its discovery, it has been used in various sophisticated experiments designed to study some fundamental problems in nuclear physics, solid-state physics and in a variety of problems in chemistry, biology, geology and metallurgy.

The aim of the present study is to construct a Mössbauer spectrometer and then to study the behaviour of its performance, which is described in Chapter III. In Chapter IV, the spectrometer was used to obtain information about the local hyperfine fields inside the $CoFe_2O_4$ ferrimagnetic spinel compound. A NaI (Tl) scintillation detector, a ND 2400 multichannel analyzer, and nuclear pulse-handling system were used to detect, sort, and store the Mössbauer gamma-ray counts in this Mössbauer transmission experiment. All of the results will be presented

in Chapter V. In Chapter II, a magnetic hyperfine field theory will be outlined. Possible further work will be discussed in Chapter VI. Special attention will be given to possible studies which could provide more verification of the theory as outlined in Chapter II.