PREFACE

This thesis is devoted to the study of the properties of nucleons at low energies The vast available data on nucleus indicate that a nucleon is a complicated system of strongly interacting quarks and gluons Naturally, we require either some nonperturbative approach or some model which can capture relevant physics. Chapter I is introductory, in which we review the relevant developments in the subject which will be useful in the course of investigating the problem discussed in the following chapters

In chapter II, we investigate some properties of nucleons related to their spin using a statistical model The various quark–gluon Fock states of a nucleon have been decomposed in a set of states in which each of the three-quark core and the rest of the stuff, termed as a sea, appears with definite spin and color quantum number, their weight being determined, statistically, from their multiplicities We have also considered two modifications of this model with a view to reduce the contributions of the sea components with higher multiplicities With certain approximations, we have calculated the quark contributions to the spin of the nucleon, the ratio of the magnetic moments of nucleons, their weak decay constant, and the ratio of SU(3) reduced matrix elements for the axial current

In chapter III, we have investigated isospin breaking in the diagonal pion-nucleon coupling constant ($g_{\pi NN}$) using conventional QCD sum rule The effect of quark mass dependent terms, π^0-η mixing and electromagnetic corrections to meson-quark vertices have been included as well Some of the implications of the isospin splitting have also been discussed

In chapter IV, we investigate gluonic contributions to the nucleon self-energy in an effective theory The couplings of the topological charge density to nucleons give rise to OZI violating η-nucleon and η'-nucleon interactions The one-loop self-energy of a nucleon arising due to these interactions have been calculated regularizing the divergences using form factors

In chapter V, we have studied anomaly-anomaly correlator using QCD sum rule This has been used to evaluate the first derivative of the topological susceptibility at zero momentum, a quantity which is useful in the discussion of the proton-spin problem

Finally, we conclude with some future outlooks