Depleting fossil fuel resources are forcing the transportation sector to look for renewable fuels. CNG, being produced from fossil as well as natural resources, is a good alternative to liquid fossil fuels. It is relatively abundant and easily available compared to hydrogen. However, it has lower flame speed, shorter flammability range and other limitations, which make it a sub-optimum fuel for IC engines. Hydrogen, which can also be produced from renewable resources, is a possible solution to some of these issues. However hydrogen has its own limitations in terms of low storage density. It occupies very large volume as a gas and storing it in liquid form is extremely energy intensive. There is a sharp contrast in vital properties of both these fuels therefore this study explores using mixtures of hydrogen and CNG as alternative fuel. This fuel exhibits merits of hydrogen as well as CNG. Hence, hydrogen enriched CNG, also known as Hythane or HCNG is being investigated worldwide. This fuel is storable, energy efficient and emits fewer emissions compared to both constituent fuels individually. One way to produce HCNG is to mix the constituent gases using Dalton's law of partial pressures and store them as premixed mixture. This method is both time consuming and cumbersome. Hence in the present study, a prototype dynamic gaseous fuel mixing system was developed, which was used to produce different HCNG mixtures dynamically, required for engine investigations with acceptable accuracy. This system facilitated change in HCNG mixture composition without the necessity of stopping the engine, making it easier to investigate a wider range of mixture compositions. Validation of this dynamic mixing system was done using theoretical and experimental approaches. This prototype mixing system was then used to investigate the technical feasibility of various HCNG mixtures ranging from 0% to 100% hydrogen enrichment of CNG at different engine loads. Combustion, performance end emission characteristics were compared for all test fuels. Results showed that HCNG mixtures with hydrogen percentage ranging from 30-40% showed superior engine performance and anti-knocking characteristics compared to other HCNG mixtures, Hydrogen and CNG.