The main goal of the present thesis is to describe the behaviour of strongly interacting matter under extreme conditions of temperature and/or net baryon densities. Two important signals regarding the characterization of strongly interacting matter namely fluctuation-correlation and invariant mass spectra of dimuon have been discussed in this thesis. Fluctuation-correlation of conserved charges has been studied using Hadron Resonance Gas (HRG) model and its interacting version namely Excluded Volume Hadron Resonance Gas (EVHRG) model. In EVHRG model, the repulsive interactions have been incorporated by considering finite hard-core radii of mesons and baryons. Ratios of cumulants of different experimental observables in heavy ion collisions have been studied using previously mentioned models and compared with the available experimental data. Fluctuations of conserved charges have also been studied using HRG model in the presence of a strong external magnetic field which is expected to be produced in non-central heavy ion collisions. Moreover, chemical freeze-out parameters have been extracted analysing experimental data of ratios of fluctuations of net-proton and net-charge measured in heavy ion collision experiment by the STAR collaboration at RHIC. In addition, thermal dilepton yield from a QGP medium has been studied at FAIR energy.

We can draw following conclusions from the present thesis:
Fluctuations and correlations of different conserved quantities have similar values both in HRG and EVHRG model at low temperature and/or low baryonic chemical potential. However, at high temperature and/or high baryonic chemical potential, magnitudes of fluctuations and correlations are smaller in EVHRG model compared to the ideal HRG model. This could be attributed to the presence of realistic hard-core repulsive interaction in the EVHRG model.

At the low temperature and $\mu_B = 0$, fluctuations and correlations of conserved charges as evaluated in HRG / EVHRG model are close to the LQCD data whereas at high temperatures, compared to HRG, second order fluctuations for conserved baryon and electric-charge from EVHRG are closer to LQCD continuum data for radius of hadrons between $0.2 - 0.3$ fm. On the other hand, for $\chi_s^2$, results of HRG model is closer to LQCD continuum data. The LQCD data ($N_f = 6, 8$) for $\chi^2_B$ and $\chi^2_S$ are in good agreement with HRG / EVHRG model up to $T = 0.16$ GeV. However, both HRG and EVHRG model overestimate LQCD data for $\chi^4_Q$. In the case of correlations, LQCD continuum data for both $\chi_{BS}^{11}$ and $\chi_{QS}^{11}$ are closer to HRG results (higher than EVHRG) at lower $T$ but rises less sharply and becomes less than HRG for higher $T$. $\chi_{BQ}^{11}$ calculated in LQCD is found to be closer to EVHRG results at lower $T$.

Ratios of lowest order fluctuations ($\sigma^2/M$), for both HRG and EVHRG model yield almost same result. In comparison with HRG model, prominent suppression of $S\sigma$ and $\kappa\sigma^2$ in EVHRG model is observed for net-proton at low $\sqrt{s_{NN}}$ where baryonic chemical potential is large. The variations of $\sigma^2/M$ and $S\sigma$ with $\sqrt{s_{NN}}$ seem to describe the experimental data well, while $\kappa\sigma^2$ shows large deviations. Though the results from EVHRG model seems to have a better agreement with the LQCD continuum data at low temperature and $\mu_B = 0$, in general the comparison with the experimental data does not provide us with a clear preference between HRG and EVHRG.

Baryon number and electric charge number susceptibilities, evaluated in HRG model, are more sensitive to the magnetic field as compared to the strangeness number susceptibilities. Among the correlators, the baryon-charge correlation is found to be the most sensitive to the magnetic field. The ratios of fluctuations that are measurable experimentally also manifest some effects of the magnetic field. The effect of magnetic field is found to be maximum for the lower order fluctuation ratios ($\langle\sigma^2/M\rangle_z$).

Chemical freeze-out parameters evaluated in HRG model, using ratios of lower
order cumulants, starts deviating from the one obtained using ratios of higher order cumulants around $\sqrt{s_{NN}} = 19.6$ GeV. This may be an indication of the approach to critical region for $\sqrt{s_{NN}} \leq 19.6$ GeV.

- In the present work it has been shown that the effect of centrality and beam energy on $\mu_B/T(\sqrt{s_{NN}}, N_{\text{part}})$ can be distinguished. This effort leads to a scaling of $(\mu_B/T)/(\mu_B/T)_{\text{central}}$ with $N_{\text{part}}/(N_{\text{part}})_{\text{central}}$. This scaling is found to work well for the chemical freeze-out parameters evaluated from ratio of lower order cumulants. It has also been observed that the chemical freeze-out parameters, which can describe $\sigma^2/M$ of net-proton very well in all beam energies and centralities, may not describe $s\sigma$ equally well and vice versa since higher order fluctuations are more sensitive near critical region.

- The thermal dimuon yield could be used as a crucial input for simulation of detector response for muons in the CBM experiment at FAIR. In the present work, as an initial effort this yield has been estimated using Bjorken hydrodynamic model at FAIR energies. However, at lower $\sqrt{s_{NN}}$, Bjorken hydrodynamics may not give the appropriate picture. Any other more realistic hydrodynamics may be considered in future.