The aim of the present work is to perform alpha decay study using two different approaches (i) Quantum tunneling in unified fission model and (ii) scattering theory as applied to decay of resonance states.

Using unified fission like approach alpha decay half lives have been calculated for proton rich Pb isotopes in the region A=182-210, Bi isotopes in the region A=189-214 and for super heavy nuclei in the region Z=106-128 and A=258-320. Also the half lives have been predicted for the nuclei in the mass region given above for those which experimental data are not available. In all the cases good agreement has been obtained with the experimental data where it is available. In the unified fission like approach alpha decay has been considered as asymmetric fragmentation of parent nucleus into alpha and daughter nucleus. Our study is different than the earlier existing studies in literature adopting fission like approach in the following ways.

(i) We have expressed the potential barrier by a highly versatile form developed by Sahu et al [Sah 02] which itself is based on the Ginnchio potential [Gin 84]. One expects that due to various renormalization effects, the shape of the barrier changes such that there is a sharp fall in the potential in the interior region. The effective barrier experienced by alpha gets modified from its simple Coulomb and centrifugal form due to various renormalization processes. This notion of modification of the fission barrier has been taken into account by choosing the appropriate values of the potential parameters, the barrier height $V_B$, top curvature $\lambda$ and range $\nu$. We have thus for the first time parameterized the full geometrical shape of the potential.

(ii) In almost all the earlier theoretical studies the transmission probability has been calculated using WKB approximation method. We have used an exact expression of transmission coefficient given by Sahu et al [Sah 02]. To test the relative accuracy of the WKB approximation method we have compared the exact transmission probabilities calculated with those obtained by WKB
method for symmetric Eckart barrier of different ranges. It has been observed that when the de Broglie wavelength of the incident particle is larger than the size of the obstacle the tunneling becomes more and more quantal and hence the semiclassical approximation becomes poorer.

(iii) The assault frequency $P_0$ has been obtained from the zero point vibration energy $E_v = \frac{1}{2} \hbar P_0$. From a fit to the experimental data on cluster emitters a law is given by Poenaru et al [Poe 84] which relates $E_v$ with Q values. The same law has been extended to alpha decay and is used to calculate vibration energies. The shell effect is implicitly contained in the zero point vibration energy due to its proportionality with the Q value. Our method of calculating the assault frequency from the zero point vibration energy is more appropriate than the method used by other authors. Tavers et [Tav 05] have used a constant value of assault frequency $2 \times 10^{21} \text{s}^{-1}$. Shanmugam et al [Sha 00] have calculated it from the relative motion of the fragments in the range described by the sum of Susmann central radii of the parent and the daughter nuclei.

Using second line of approach the alpha decay half lives and decay energy have been calculated for recently discovered alpha decay chain of $^{294}$117 and $^{293}$117. We have also predicted the alpha decay energy and alpha decay half for the isotopic chain of Z=74, 102 and 113, for which experimental data are not known. In this approach the decaying state has been considered as the resonance state of the alpha-daughter nucleus system with in the frame work of quantum scattering theory. This approach is different from other theoretical approaches in the following way

(i) For this study we have used an analytical expression of the alpha-daughter potential which simulates nuclear Wood-Saxon part in the interior of the barrier and repulsive Coulomb form in the outer region of the barrier.
(ii) To estimate the resonance energy or Q value of the decaying state, confinement property and bound state like behavior of the wave function at resonance state has been taken into account.

(iii) To calculate decay width or half life an analytical expression has been used. The expression has been obtained by matching the interior wave function with the outside Coulomb wave function.

The method used in the present work to calculate decay energy and half life is simple and free from any other difficulties experienced in other methods e.g S-matrix, Imaginary Phase shift method, Imaginary test potential method and quantum tunneling using WKB method. In the quantum tunneling method with WKB approximation, which has been used in almost all the earlier studies the decay constant has been calculated as the product of assault frequency and penetrability factor through the barrier. In the present approach there is no need of assault frequency only wave function method has been used to calculate decay constant. Also in the present work a global formula has been developed. The formula has been used in the prediction of half life and decay energy of experimentally unknown systems. To check the reliability of the formula predicted results has been compared with the experimental data, for the cases where experimental data is available. Results have been found in very good agreement with the experimental data. Thus the global formula can be used freely for the prediction of decay energy and decay half lives of unknown systems.