In this thesis we discuss the transport of waves in disordered media. In the first part we investigate light transport through an active random medium. In the second part the electron (as a quantum wave) transport through a disordered system is investigated.

In Chapter 2, the appropriateness of using a complex refractive index for amplification by considering light scattering through a region with a complex refractive index given by,

\[ \eta(x) = (\eta_r + i\eta_i)\delta(x) \]

is investigated. It is shown for the first time that the amplification and reflection are concomitant and that in the absence of mismatch between the real part of refractive index there is no unbounded amplification. The transport coefficients of a random ensemble of such \( \delta \)-function scatterers, is also investigated.

In Chapter 3, the probability distribution of the reflection coefficient for light reflected from a one-dimensional random amplifying medium with cross-correlated spatial disorder in the real and imaginary parts of the refractive index is derived using the method of invariant imbedding. The statistics of fluctuations have been obtained for both the correlated telegraph noise and the Gaussian white noise models for the disorder. In both cases an enhanced backscattering (super-reflection with reflection coefficient grater than unity) results because of coherent feed back due to Anderson localization and coherent amplification in the medium. The results show that the effects of randomness in the imaginary part of
the refractive index on localization and super-reflection are qualitatively different.

In Chapter 4, the Fokker-Planck equation for the probability distribution of the reflection coefficient of the light incident on a one-dimensional active random medium in which the background profile varies with length is derived. We find that the effective amplification of the system of finite length depends on the gradient of the variation of the background profile.

In Chapter 5, by considering a network of dirty Luttinger liquid wires and following Midgal-Kadanoff type bond moving procedure we derive the renormalization group equations for the characteristic function of the full probability distribution of conductance of two and three dimensional Luttinger liquid networks. In two dimension we get a new phase with the average conductance independent of sample size (L). The second cumulant $a_2$ has $1/L$ dependance and saturates to a disorder dependant constant $\gamma$. In three dimension we get two different phases one with $L$ independent average and with second cumulant decreasing as $1/L$ and saturating to a non zero value. The second phase has an average conductance which for large $L$ decreases as $L^{-2}$ and the second cumulant for large $L$ increases as $L$. All the other higher cumulants in both dimensions exponentially decrease with $L$.

In Chapter 6, the exact tunneling conductance for a two-channel quantum wire modeled as a Luttinger liquid is derived. This is also applicable to the case of a Luttinger liquid loop with two of its points maintained at different potentials. In addition to the oscillations seen in one channel case the Aharonov-Bohm type of
oscillations due to electrons moving in the loop as modeled by two-channel Luttinger liquid is also seen. An exact expression for the tunneling conductance at finite bias of a multi-channel Luttinger liquid bundle is also derived.

**Research Papers Published/Communicated:**


5. Tunneling conductance of Luttinger liquid loops and bundles; E. Krishna das, G.V. Vijayagovindan and Indulekha K. (Communicated to IJMP B).
