effect have been effectively utilised for different types of studies associated with laser technology. One of the important work presented is the design and fabrication of a laser power meter based on PA effect. This laser power meter is capable of detecting all wavelengths from near ultraviolet to far infrared region. Subsequently a measuring range from 5 w to 10 w is obtained which represents a considerable improvement over similar devices reported earlier. This set up has been successfully employed in the laser attenuation measurement in the atmosphere using a He-Ne laser. From the result it is found that the pollution is maximum at 2 am in Cochin University campus.

Similarly PA studies have been extended to study the thermal diffusivity of Copper and CeO2 films for different thicknesses and this method offers a promising tool for the precise measurement of thermal parameters of such samples. These studies in fact revealed the possibility of identifying the thermal parameters associated with dielectric materials which are needed for the development of high quality optical materials for laser systems.

A current stabilised CW CO2 laser has been designed and fabricated. It essentially consists of two water cooled plasma tubes of lengths 75 cm each are optically in series but electrically in parallel. Solid state circuitry is employed for current stabilisation and control. Stabilised CW laser beam in the 10.6 μm region upto 30 Watts is available from this system. Parametric studies of the current regulated CW CO2 laser have been carried out using a photoacoustic laser power meter. The detailed study of variation of laser power with plasma tube current levels at a fixed gas pressure gives the parameters for optimising the operating conditions. It is found that the addition of water vapour at 0.3 torr improves the power level beyond 30 W.

This CO2 laser has been successfully employed for material processing in silicon wafers. The optical transmission through this wafer is measured as a function of time using the photoacoustic laser power meter. It is observed that the transmission coefficient decreases with the time and in 10-15 seconds it reaches a steady value. Thus the absorption coefficient could be determined at this temperature from which the free carrier concentration in an intrinsic semiconductor is accurately calculated.


With the advent of lasers, there has been a revived interest in the field of underwater optical systems. Lasers, because of their low divergence, narrow bandwidth and high power are ideal sources for underwater optical communication, ranging and photography. In order to develop any under water optical system, the region of minimum attenuation of light in water must be identified. The search for an optical window demands an extensive study of the transmission characteristics of sea water for different wavelengths in the visible region. The sea water constituents are of two types, the dissolved salts which are mostly in ionic state and the suspended particles such as organic matter and dust. The dependence of optical attenuation on the concentration of these constituents is an essential scientific information to be gathered; the sea water being in random turbulent motion, the laser propagation in a turbulent medium...
is also a related area of importance. The variations in the temperature and salinity of sea water will give rise to variations in the refractive index of the medium. Even though the refractive index variation from the mean value is small, in a situation of practical interest, a propagating laser beam encounters a large number of inhomogeneities resulting in a significant cumulative effect. The central theme of the work presented in the thesis is a careful investigation of the factors influencing the attenuation of laser beams through sea water.

The thesis presents a detailed report of the work done by the author on the attenuation studies in sea water and some effects of turbulent medium on laser propagation. The thesis contains six chapters. The first chapter gives an introduction to the subject of laser propagation through sea water. A review of the earlier work on attenuation studies in water is included in this chapter. The theoretical background of the problem of laser propagation through a turbulent medium is summarized in the last part of this chapter.

Chapter II gives the fabrication details of a nitrogen laser pumped dye laser used for the attenuation studies in sea water. For the dye laser, a holographic grating is used in grazing incidence. The laser gives 3 ns pulses of 0.04 nm line-width. Using different dyes, the laser is tuned from 425 nm to 630 nm. The parametric studies of the dye laser which form an important part of the required instrumentation are also reported in this chapter.

The experimental setup for the attenuation measurements is described in chapter III. The split-pulse laser method is adopted using a nitrogen laser pumped dye laser as the source. The laser pulse is split into two by a beam splitter; one part of which goes through a 20 cm long reference cell and the other part goes through a 500 cm long sample cell. The pulses are reflected back by the mirrors kept at the end of these cells and are detected by a photodiode. The advantages of this technique over other high sensitive absorption measurement methods are described in this chapter.

In chapter IV, the results of attenuation studies in distilled water, synthetic sea water and natural sea water are described. Several authors had reported the attenuation coefficients of distilled water. But these values are found to differ from the present values. Hence the optical attenuation in distilled water is re-investigated using the present setup.

Attenuation studies of sea water form a major part of this chapter. In order to determine the effect of dissolved constituents of sea water on attenuation, the measurements are conducted in synthetic sea water prepared by dissolving the respective chemicals in the right proportion in doubly distilled water. Two samples of synthetic sea water are studied. The first sample contains only the major constituents and the second sample contains the major and minor constituents. The nature of attenuation curves are found to be similar to that of distilled water. It is concluded that the presence of minor constituents in the present concentration levels has negligible effect on optical attenuation. The details of sample preparation, experimental procedure and results are reported.

The results of the studies on two samples of natural sea water are reported in the last part of chapter IV. The two samples collected from the Arabian sea are - one from 3 Km. off the coast and the other from 30 Km. off the coast. These samples are filtered using whatman grade 1 filter paper to remove large scale suspended particles. The attenuation be much higher than that for synthetic sea both being almost same, the high value of water is concluded to be due to the presence of particles collected from 3 Km off the coast sh the increased effect of suspended particles.

Chapter V describes the details of the laser through a turbulent medium. Experiments are turbulent medium. The laser propagation through a turbulent medium, are studied using a He-Ne and a He-Ne laser with a high sensitive absorption measurement. The change in the variance of log-squared shows a saturation behaviour, as reported for the power spectrum of the incoherent incoherent turbulence, in agreement with the Kolmogorov model.

A new method of qualitative characterization is proposed in this chapter. The time series of measurements is Fourier analysed to obtain the Fourier space show certain characteristics, turbulence. It is also found that the phase turbulence qualitatively.

Quantitative characterization is also done of K entropy which gives a quantitative picture of turbulence.

Chapter VI gives the general conclusions arrived at from the earlier chapters. There is no clear definite However, because of the high scattering intensity of the propagated laser beam, due to the high scattering from the medium, a large amount of suspended particles have lesser effect on the attenuation. The turbulence as a whole, has much lesser effect on the attenuation than the increased effect of suspended particles. The attenuation of a sample collected from 3 Km. off the coast is concluded to be due to the presence of large scale suspended particles. The attenuation of a sample collected from 30 Km. off the coast is concluded to be due to the increased effect of suspended particles.

The thesis work is mainly centered on the study of the chaotic state are fascinating phenomena of dissipative dynamical systems. It is found that the transition from the regular behaviour to the chaotic regime occurs. The chaos is characterized by the presence of strange attractors, fractal dimension, and the power spectrum of the laser intensity. The chaotic behaviour is also verified by the presence of positive Lyapunov exponents.
The variations in the temperature and to variations in the refractive index of the index variation from the mean value is small. The propagating laser beam encounters a large amount of scatter in a significant cumulative effect. The central thesis is a careful investigation of the factors beams through sea water. A review of the earlier work is included in this chapter. The theoretical propagation through a turbulent medium is chapter.

Details of a nitrogen laser pumped dye laser sea water. For the dye laser, a holographic cell. The laser gives 3 ns pulses of 0.04 nm -laser is tuned from 425 nm to 630 nm. The which form an important part of the required equipment.

A new method of qualitative characterising the hydrodynamic turbulence is proposed in this chapter. The time series obtained from the fluctuating intensity measurements is Fourier analysed to obtain the $a_n$ and $b_n$ coefficients. The points are connected with lines to follow the path of K entropy gives a quantitative picture of the strength of turbulence averaged over the path.

Chapter VI gives the general conclusions drawn from the results reported in the earlier chapters. There is no well defined optical window for sea water. However, because of the high scattering loss in the blue region and high absorption in the red region, there is a broad minimum for the attenuation at around 500 nm. It is further concluded that the attenuation of sea water essentially depends on the amount of suspended particles present. The dissolved constituents have lesser effect on the attenuation. The behaviour of the fluctuations in the intensity of the propagated laser beam, due to the variation in the temperature of the water medium is similar to that in the case of the atmosphere. The major difference between the two cases is in the time scales in which the fluctuations occur.


The thesis work is mainly centered on the asymptotic behaviour of nonlinear nonintegrable dissipative dynamical systems. It is found that such systems exhibit random behaviour or chaos. The nature of the onset of chaos and the statistical description of the chaotic state are fascinating fields of study. One of the