# Abstract

A new modification of the spherical harmonic method has been used to solve radiative transfer equation in both planar and spherical geometry. The radiative transfer equation is an integro-differential equation and general solution to this equation is difficult to develop because of the complex mathematical form of the governing equation. Several different methods have been developed over the years, some of which have been exact but many of them have been approximate. Among the approximate methods, the spherical harmonic method is perhaps the most tedious but elegant method. A modified form of the spherical harmonic method is used to solve various problems in radiative transfer.

In the modified form, the intensity forms are taken in the following manner

$$I^{+}(\tau,\mu) = I(0,0)\left[\phi(\tau) + \psi(\mu) + \sum_{l=0}^{l=L}(2l+1)I_l^{+}(\tau)\mu P_l(2\mu - 1)\right], \quad 0 \le \mu \le 1,$$

$$I^{-}(\tau,\mu) = I(0,0)\left[\phi(\tau) + \psi(\mu) + \sum_{l=0}^{l=L}(2l+1)I_l^{-}(\tau)\mu P_l(2\mu + 1)\right], \quad -1 \le \mu \le 0,$$

where I(0,0) is some constant, $\phi(\tau)$ is a function of $\tau$ only.

In chapter 2, problems in semi-infinite plane parallel atmosphere are considered and solved by means of this modified spherical harmonic method. The function $\phi(\tau)$ has the form $A\tau$, where A being some constant. Throughout this chapter, we have used this particular form and calculated results for emergent intensity. Phase functions like i) isotropic, ii) Rayleigh and iii) general phase function have been used and the results in the first two cases are in very good agreement with those of Chandrasekhar.

In chapter 3, the form of $\phi(\tau)$ has been taken $Ae^{\tau} + Be^{-\tau}$ as, where A, B are constants and $\tau$ is the optical depth. The transfer equation is solved considering finite atmosphere. Five phase functions, viz. Isotropic, Rayleigh, planetary, Henyey - Greenstein and general phase functions have been considered and in first four cases the expressions for source function are obtained.

The problem of spherical atmosphere with isotropic scattering has covered in chapter 4.The form of $\phi(r)$, [ r being the radius of curvature ] is modified to suit boundary conditions and this is taken as

$$\phi(r) = \alpha + \frac{\beta}{r} + \frac{\gamma}{r^2} + \frac{\delta}{r^3} + e^{kr}\left[\frac{A}{r} + \frac{B}{r^2} + \frac{C}{r^3}\right]$$

Finally in chapter 5, different approximate forms of H-functions have been used to calculate values of H-function for various values of albedo. H-functions are calculated ( since these have been used in chapter 2 ) to find the emergent intensity in semi-infinite atmosphere. The results obtained for various approximate forms of H-function are compared with those of Chandrasekhar and these are found to be in good agreement.