In this study, by constructing a set of matrix equations we calculate the Gaunt coefficients which are defined as the integral of the product of three spherical harmonics located at the same center over whole solid angle.

These matrix equations are constructed by using the well known expression giving the product of two spherical harmonics located at the same center as a linear combination of spherical harmonics at the same center. This expression is rewritten for $\varphi=0^\circ$ so that there is only $\theta$ dependence and by rewriting this equation for as many $\theta$ values as the required number of Gaunt coefficients we construct a system of linear equations. While constructing these linear system of equations, we have preferred recursive relations for the calculation of spherical harmonics for keeping a high level of accuracy.

Gaunt coefficients are the unknowns of this system of equations and they are obtained by the Gauss-Jordan elimination method. Our calculations indicate that this method especially for large quantum numbers yields results better than those obtained with other methods.

**Key Words:** Gaunt Coefficients, Clebsch-Gordan Coefficients, Spherical Harmonics