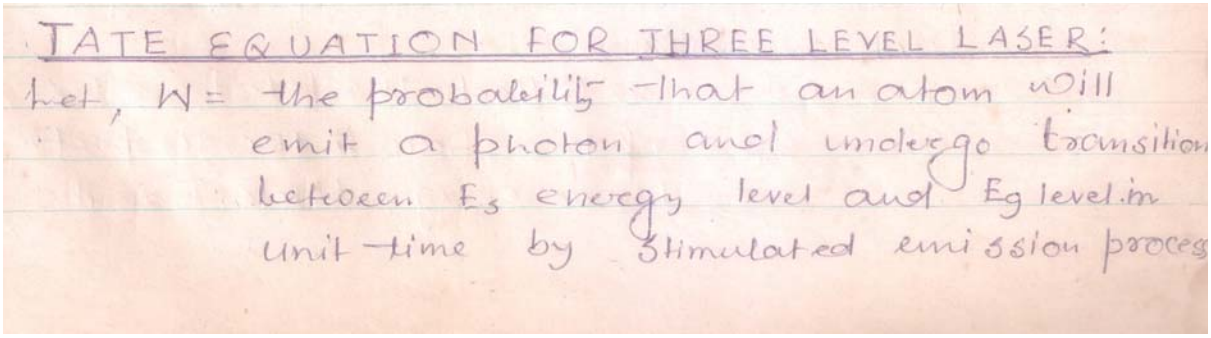

TATE EQUATION FOR THREE LEVEL LASER:

Let, W = the probability that an atom will emit a photon and undergo transition between E_3 energy level and E_g level in unit time by stimulated emission proces

P_{gs} = Total probability of induced transition from E_g to E_s States due to optical pumping.

Then $P_{gs} = \int g_s W d\nu$

Where the integration is carried over the entire band width of $(E_g - E_s)$ pump transition and with g_s as the Statistical weight of E_s level occupation.

Let N_g, N_s and N_m be the number of atoms in E_g, E_s and E_m energy levels with g_g, g_s & g_m Statistical weights respectively.

let τ_s and τ_m be mean life of an excited atom in E_s and E_m States

The total number of atoms leaving and entering E_s and E_m States by any transition is obtained by the equations

$$\frac{dN_s}{dt} = -\frac{N_s}{\tau_s} + \left(N_g - \frac{g_g}{g_s} \cdot N_s\right) P_{gs}$$

and $$\frac{dN_m}{dt} = \frac{N_s}{\tau_{sm}} - \frac{N_g}{\tau_m}$$

The equations are the rate equation for three level transitions.

$\frac{1}{\tau_s}$, $\frac{1}{\tau_m}$, $\frac{1}{\tau_{sm}}$ are called the total rates of transition to the respective lower energy levels. Transition

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into a state is shown positive and those outof a state is shown with a minus sign.