The renormalization group equation for $\lambda$ will now be:

$$\frac{d\bar{\lambda}}{dt} = \beta_\lambda(\bar{\lambda},\bar{g}) \qquad \bar{\lambda}(t = 0,\lambda) = \lambda \tag{6.4}$$

where

$$\beta_\lambda = \mu \frac{\partial\lambda}{\partial\mu}\Bigg|_{\lambda_u, g_u, \alpha_u, \Lambda \text{ fixed.}} \tag{6.5}$$

Once again it is sufficient to calculate the logarithmically divergent corrections, in the one loop approximation, to the quartic scalar vertex. These are illustrated in Figure 10. (The graphs in Figure 11-C should be divided by two since it is the square root of the wave function renormalization constant that enters the renormalization group equations). The terms illustrated in Figure 11, a, b, c, and d contribute to $\beta_\lambda$ terms of-order $\lambda^2, \lambda g^2, \lambda g^2$ and $g^4$ respectively. We therefore obtain an equation for the effective coupling constant $\bar{\lambda}$:

$$\frac{d\bar{\lambda}}{dt} = A\bar{\lambda}^2 + B'\bar{\lambda}\bar{g}^2 + C\bar{g}^4. \tag{6.6}$$

The values of A, $B'$ and C are readily calculated (they are gauge independent, but it is simplest to evaluate them in Landau gauge):

$$A = \frac{1}{8\pi^2} \quad (N + 4) \tag{6.7}$$

$$B' = -\frac{1}{8\pi^2} \quad \frac{3(N^2 - 1)}{N} \tag{6.8}$$

$$C = \frac{1}{8\pi^2} \quad \frac{3(N - 1)(N^2 + 2N - 2)}{4N^2} \tag{6.9}$$

Equation (6.6) is most easily analyzed by introducing the parameter:

$$\alpha = (\bar{g})^{-2}\,\bar{\lambda};\ \alpha(o) = g^{-2}\,\lambda \tag{6.10}$$