$$\Phi[x]=\left(\prod_{s=-\infty}^{\infty}\int_{-\infty}^{\infty}de_s\sum_{i(s)=1}^{2}\right)A[e,i]\prod_{k=-\infty}^{\infty}u_{e(k)i(k)}(x^k)$$

$$H=H_0+\beta H_1$$

$$A[e,i]=\sum_{r=0}^{\infty}\beta^r A_r[e,i]$$

$$H_0\prod_{k=-\infty}^{\infty}u_{e(k)i(k)}(x^k)=\frac{1}{2m\varepsilon\alpha^2}\left[\sum_{k'=-\infty}^{\infty}e(k')\right]\prod_{k=-\infty}^{\infty}u_{e(k)i(k)}(x^k)$$

$$=\left(\prod_{r=-\infty}^{\infty}\int_{-\infty}^{\infty}de'_r\sum_{j(r)=1}^{2}\right)D_0[e,i;e',j]\prod_{k=-\infty}^{\infty}u_{e'(k)j(k)}(x^k)$$

$$\boxed{D_0[e,i;e',j]=\frac{1}{2m\varepsilon\alpha^2}\left[\sum_{k'=-\infty}^{\infty}e(k')\right]\prod_{k=-\infty}^{\infty}\delta_{i(k)j(k)}\delta(e_k-e'_k)}$$

$$H_1\prod_{k=-\infty}^{\infty}u_{e(k)i(k)}(x^k)=-\frac{1}{\varepsilon\alpha}\sum_{k=-\infty}^{\infty}\int_{-\infty}^{\infty}de'\,\eta_{i(k)}(e_k,e')\int_{-\infty}^{\infty}de''\,\xi_{i(k+1)}(e_{k+1},e'')$$

$$\cdots u_{e(k-1)i(k-1)}(x^{k-1})\,u_{e',3-i(k)}(x^k)\,u_{e'',3-i(k+1)}(x^{k+1})\,u_{e(k+2)i(k+2)}(x^{k+2})\cdots$$

$$=\left(\prod_{r=-\infty}^{\infty}\int_{-\infty}^{\infty}de'_r\sum_{j(r)=1}^{2}\right)D_1[e,i;e',j]\prod_{k=-\infty}^{\infty}u_{e'(k)j(k)}(x^k)$$

$$\boxed{D_1[e,i;e',j]=-\frac{1}{\varepsilon\alpha}\sum_{k=-\infty}^{\infty}\cdots\delta_{i(k-1)j(k-1)}\delta(e_{k-1}-e'_{k-1})\,\delta_{3-i(k),j(k)}\eta_{i(k)}(e_k,e'_k)\,\delta_{3-i(k+1),j(k+1)}\xi_{i(k+1)}(e_{k+1},e'_{k+1})\,\delta_{i(k+2)j(k+2)}\delta(e_{k+2}-e'_{k+2})\cdots}$$

$$\boxed{H\Phi[x]=0}$$

$$\left(\prod_{r=-\infty}^{\infty}\int_{-\infty}^{\infty}de'_r\sum_{j(r)=1}^{2}\right)\left(\prod_{s=-\infty}^{\infty}\int_{-\infty}^{\infty}de_s\sum_{i(s)=1}^{2}\right)A[e,i]\{D_0[e,i;e',j]+\beta D_1[e,i;e',j]\}\prod_{k=-\infty}^{\infty}u_{e'(k)j(k)}(x^k)=0$$

$$\therefore\ \left(\prod_{s=-\infty}^{\infty}\int_{-\infty}^{\infty}de_s\sum_{i(s)=1}^{2}\right)A[e,i]\{D_0[e,i;e',j]+\beta D_1[e,i;e',j]\}=0$$