$$D(t_1-t_2)\rightarrow\frac{i}{\hbar}\left[-\frac{m}{2}\delta^{(2)}(t_1-t_2)-\frac{k}{2}\delta(t_1-t_2)\right]$$

$$\Phi[\chi]=\exp\int dt_1\int dt_2\,\chi(t_1)D(t_1-t_2)\chi(t_2)$$

$$\rightarrow\exp\left\{\frac{i}{\hbar}\int dt\left[\frac{m}{2}[\dot{\chi}(t)]^2-\frac{k}{2}[\chi(t)]^2\right]\right\}$$

$$\int_0^T dt\left[\frac{\delta}{\delta\chi(t)}\right]^2\Phi[\chi]$$

$$=[4\int dt_1\int dt_2\,\chi(t_1)\int dt\,D(t_1-t)D(t-t_2)\chi(t_2)$$

$$+2TD(0)]\Phi[\chi]$$

$$\rightarrow\left\{2TD(0)-\frac{1}{\hbar^2}\int_0^T dt\left[m^2[\ddot{\chi}(t)]^2\right.\right.$$

$$\left.\left.-2mk[\dot{\chi}(t)]^2+k^2[\chi(t)]^2\right]\right\}\Phi[\chi]$$