From (5),

$$i_o = \frac{1}{2}\mu_n C_{ox}\frac{W}{L} V_{in}\sqrt{\frac{8 I_D}{\mu_n C_{ox}\frac{W}{L}} - V_{in}^2}$$

$$V_{GS} = \frac{V_{GS1} + V_{GS2}}{2} \Leftarrow \text{DC - Bias voltage of NMOS}$$

$$I_D = \frac{1}{2}\mu_n C_{ox}\frac{W}{L}(V_{GS} - V_{th})^2$$ apply

$$\Rightarrow i_o = \frac{1}{2}\mu_n C_{ox}\frac{W}{L} V_{in}\sqrt{4(V_{GS}-V_{th})^2 - V_{in}^2}$$

$$= \mu_n C_{ox}\frac{W}{L}(V_{GS}-V_{th}) V_{in}\sqrt{1 - \frac{V_{in}^2}{4(V_{GS}-V_{th})^2}}$$

(if) $V_{in} \ll 2(V_{GS}-V_{th})$

$\sqrt{1-x} \simeq 1 - \frac{x}{2}$

$$\simeq \mu_n C_{ox}\frac{W}{L}(V_{GS}-V_{th}) V_{in}\left(1 - \frac{V_{in}^2}{8(V_{GS}-V_{th})^2}\right)$$

$$= \mu_n C_{ox}\frac{W}{L}(V_{GS}-V_{th})\left(V_{in} - \frac{1}{8(V_{GS}-V_{th})^2}V_{in}^3\right)$$

$$\Rightarrow \alpha_1 = g_m = \mu_n C_{ox}\frac{W}{L}(V_{GS}-V_{th})$$

$$\alpha_2 = 0$$

$$|\alpha_3| = \mu_n C_{ox}\frac{W}{L}(V_{GS}-V_{th})\frac{1}{8(V_{GS}-V_{th})^2}$$