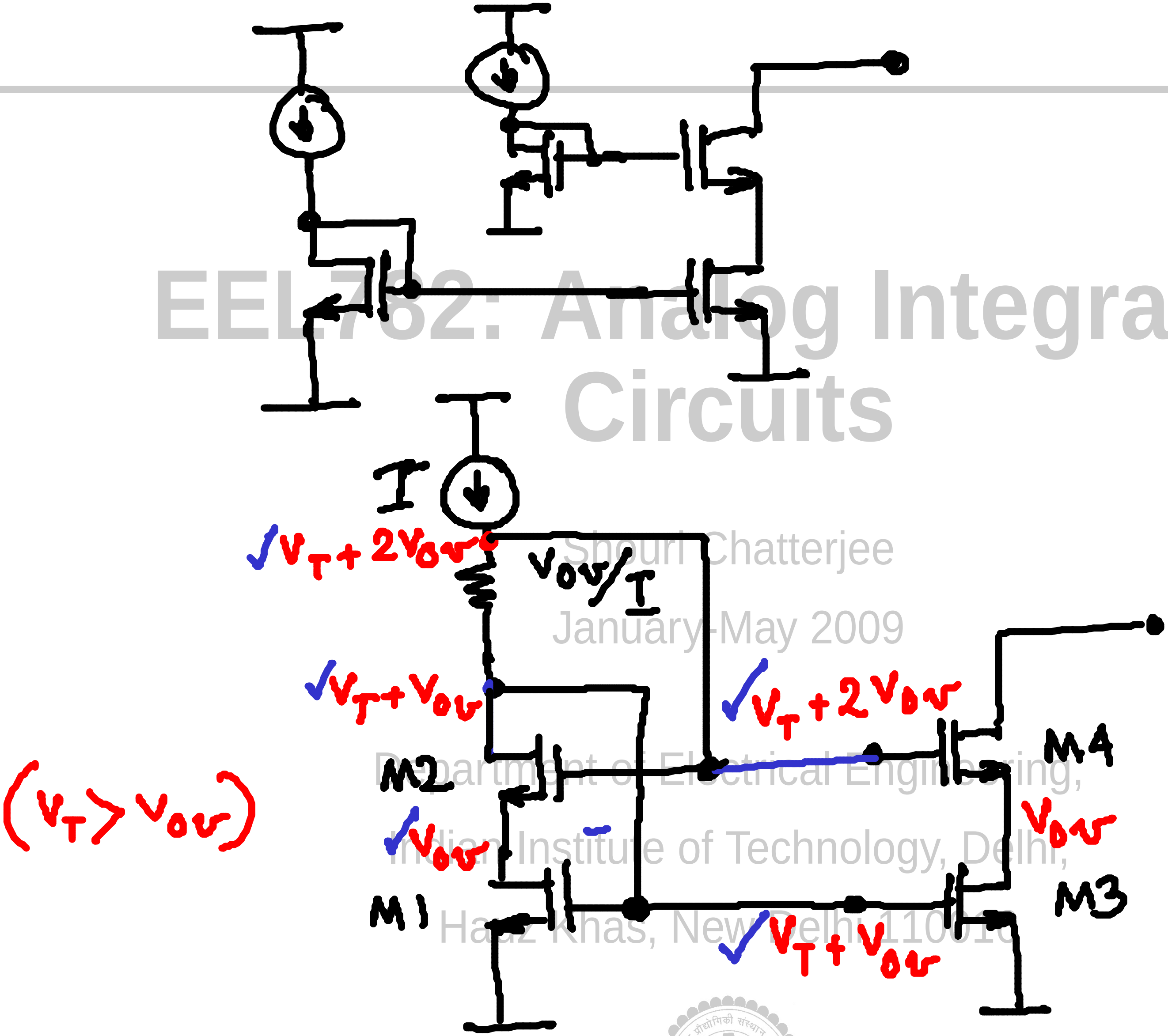
EEL782: Analog Integrated Circuits

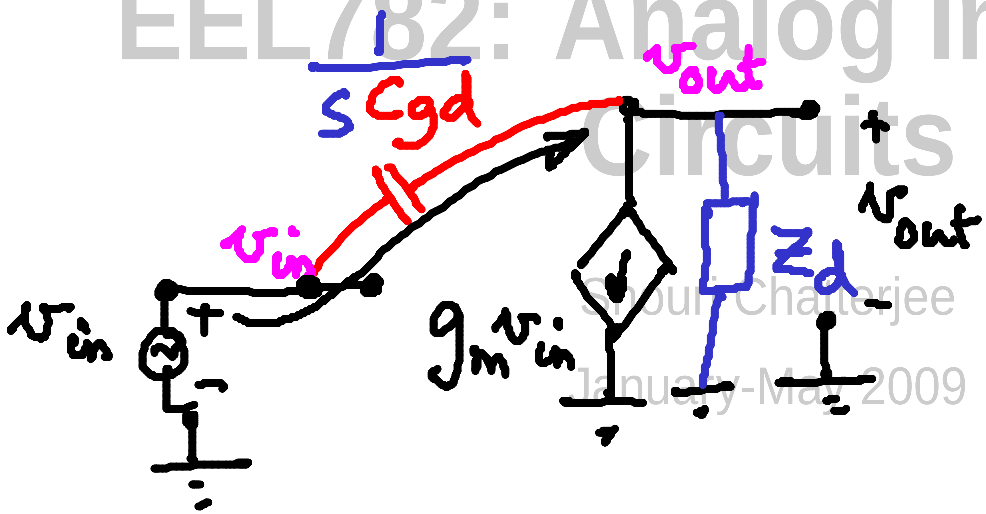


Shouri Chatterjee

January-May 2009

Department of Electrical Engineering,
Indian Institute of Technology, Delhi,
Hauz Khas, New Delhi 110016

Common source



$$v_{out} = -g_m v_{in} r_{ds}$$

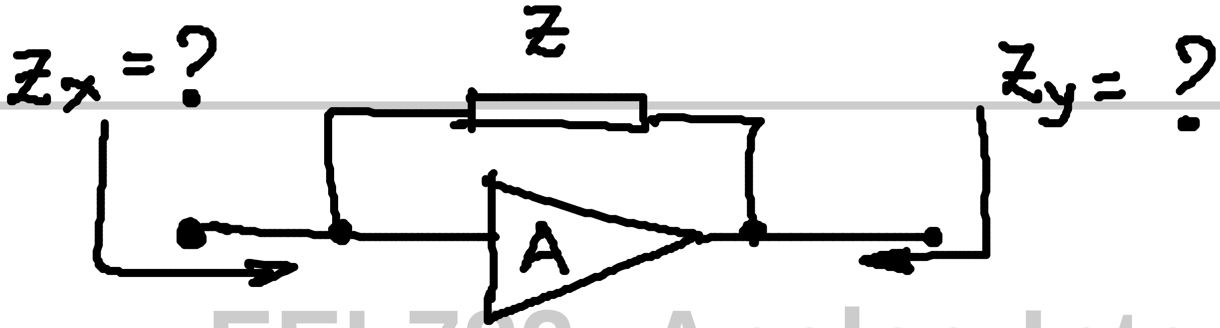
$$A_v = \frac{v_{out}}{v_{in}} = -g_m r_{ds}$$

$$Z_d = \frac{1}{sC_{db} + \frac{1}{r_{ds}}} = \frac{r_{ds}}{1 + sC_{db} r_{ds}}$$

$$\{1 + s r_{ds} (C_{db} + C_{gd})\}$$

$$\frac{v_{out}}{Z_d} + v_{out} sC_{gd} = -g_m v_{in} + v_{in} sC_{gd}$$

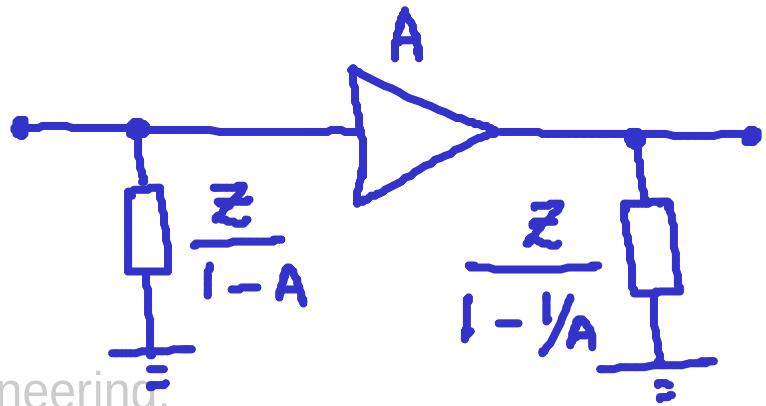
$$\frac{v_{out}}{v_{in}} = \frac{-g_m + sC_{gd}}{1/Z_d + sC_{gd}}$$



EEL782: Analog Integrated Circuits

$$Z_x = \frac{Z}{(1-A)}$$

$$Z_y = Z/(1-1/A)$$



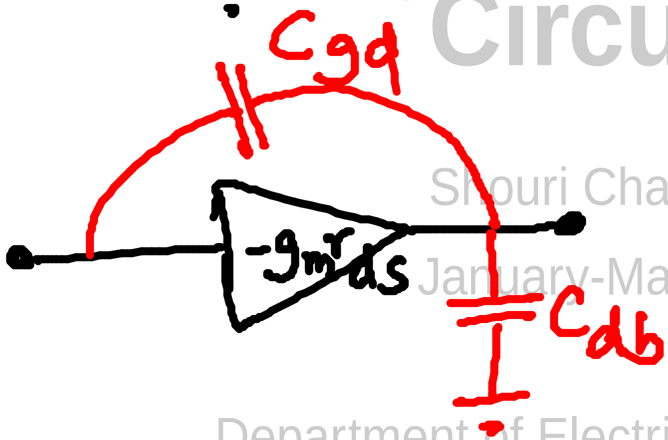
Shouri Chatterjee

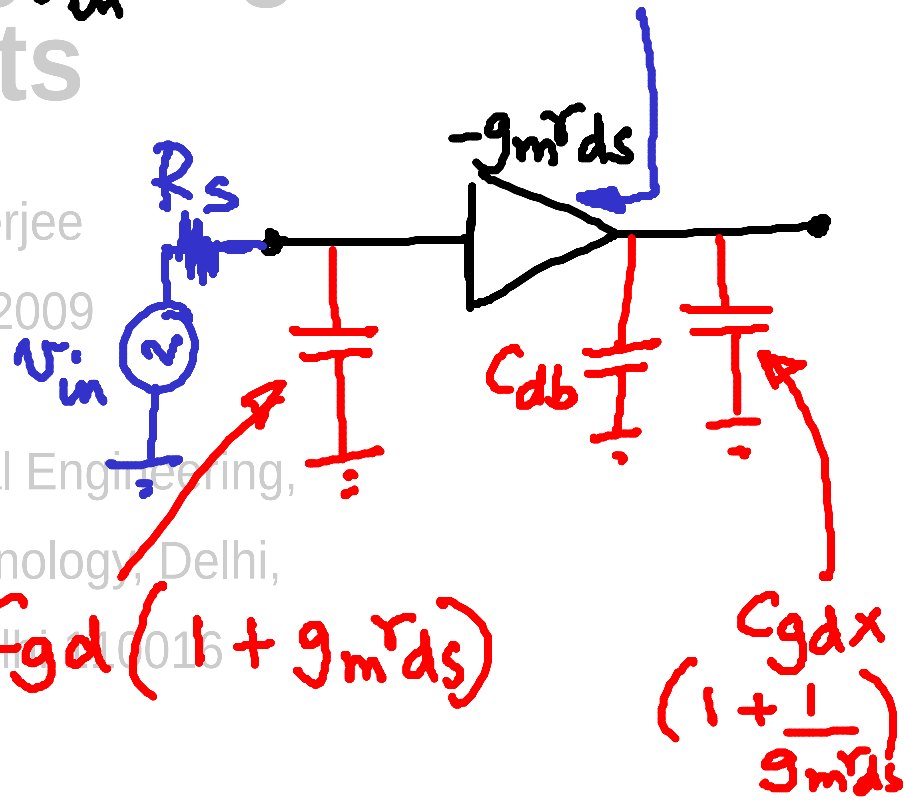
January-May 2009

Department of Electrical Engineering,
Indian Institute of Technology, Delhi,
Hauz Khas, New Delhi 110016

EEL782: Analog Integrated Circuits

$$\frac{v_{out}}{v_{in}} = -g_m r_{ds}$$





Shouri Chatterjee

January-May 2009

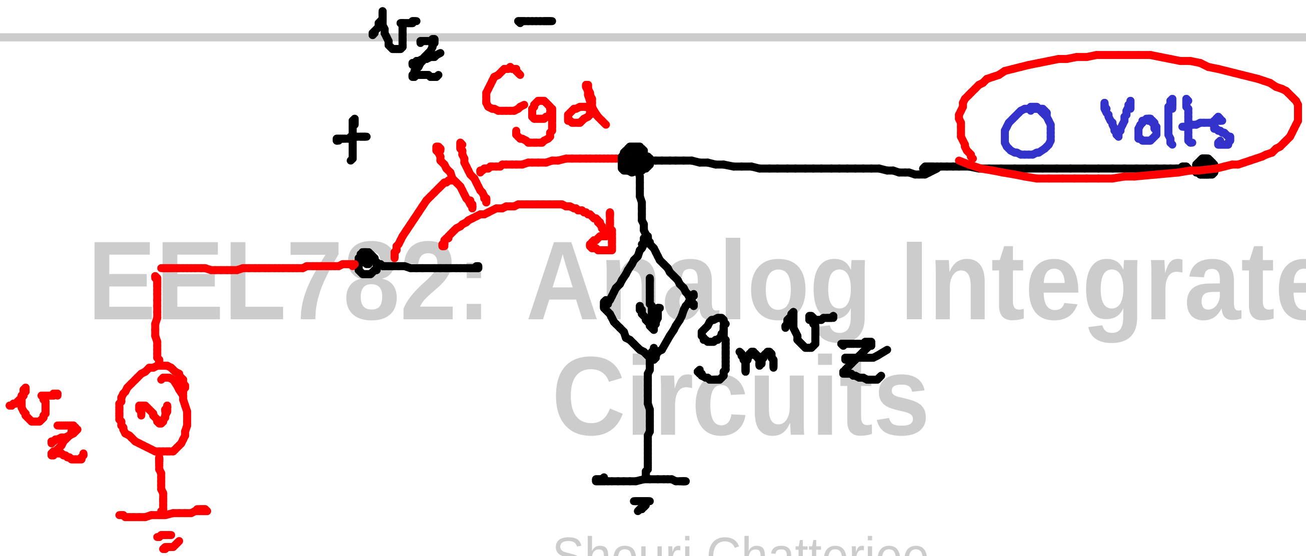
Department of Electrical Engineering,

Indian Institute of Technology, Delhi,

Hauz Khas, New Delhi 110016

$$\frac{\cdots}{1+s r_{ds}\left(C_{db}+\left(1+\frac{1}{g_m r_{ds}}\right)C_{gd}\right)}$$

EEL782: Analog Integrated Circuits



Shouri Chatterjee

January-May 2009

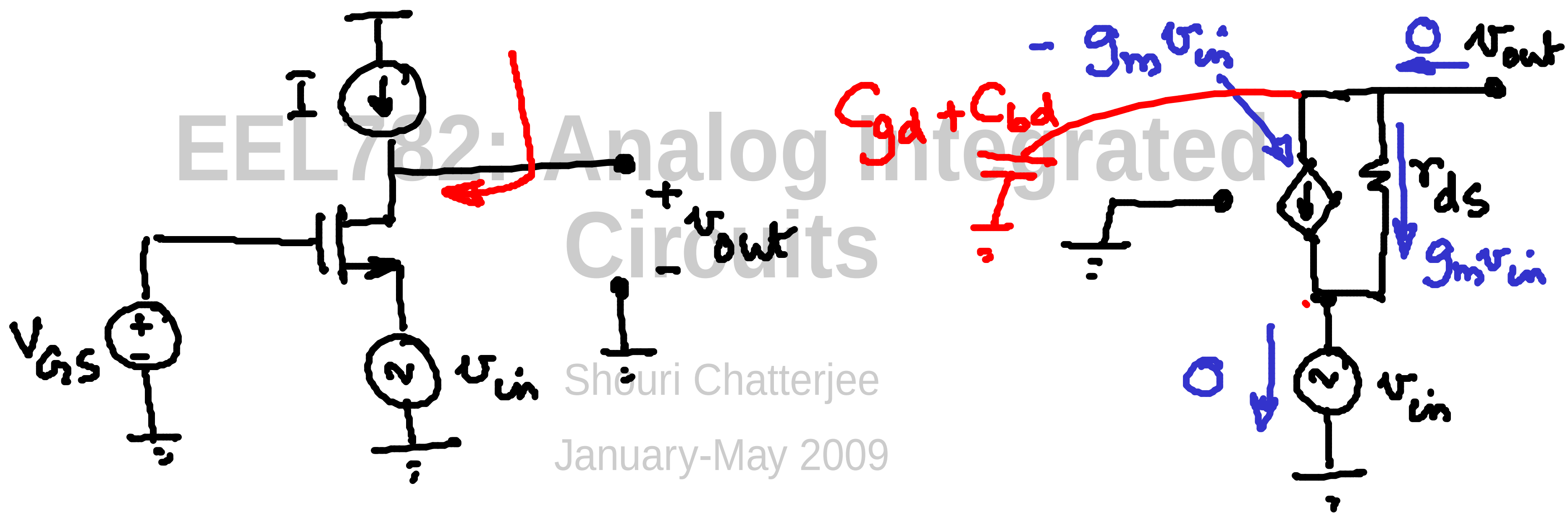
$$1 = \frac{1}{s_z C_{gd}} \cdot g_m \qquad s_z = g_m / C_{gd}$$

Department of Electrical Engineering,

Indian Institute of Technology, Delhi,

Hauz Khas, New Delhi 110016

Common gate



$$v_{out} = v_{in}(1 + g_m r_{ds})$$

$$\frac{v_{out}}{v_{in}} = 1 + g_m r_{ds}$$

Pole at : $\dfrac{1}{r_{ds}(C_{gd} + C_{bd})}$

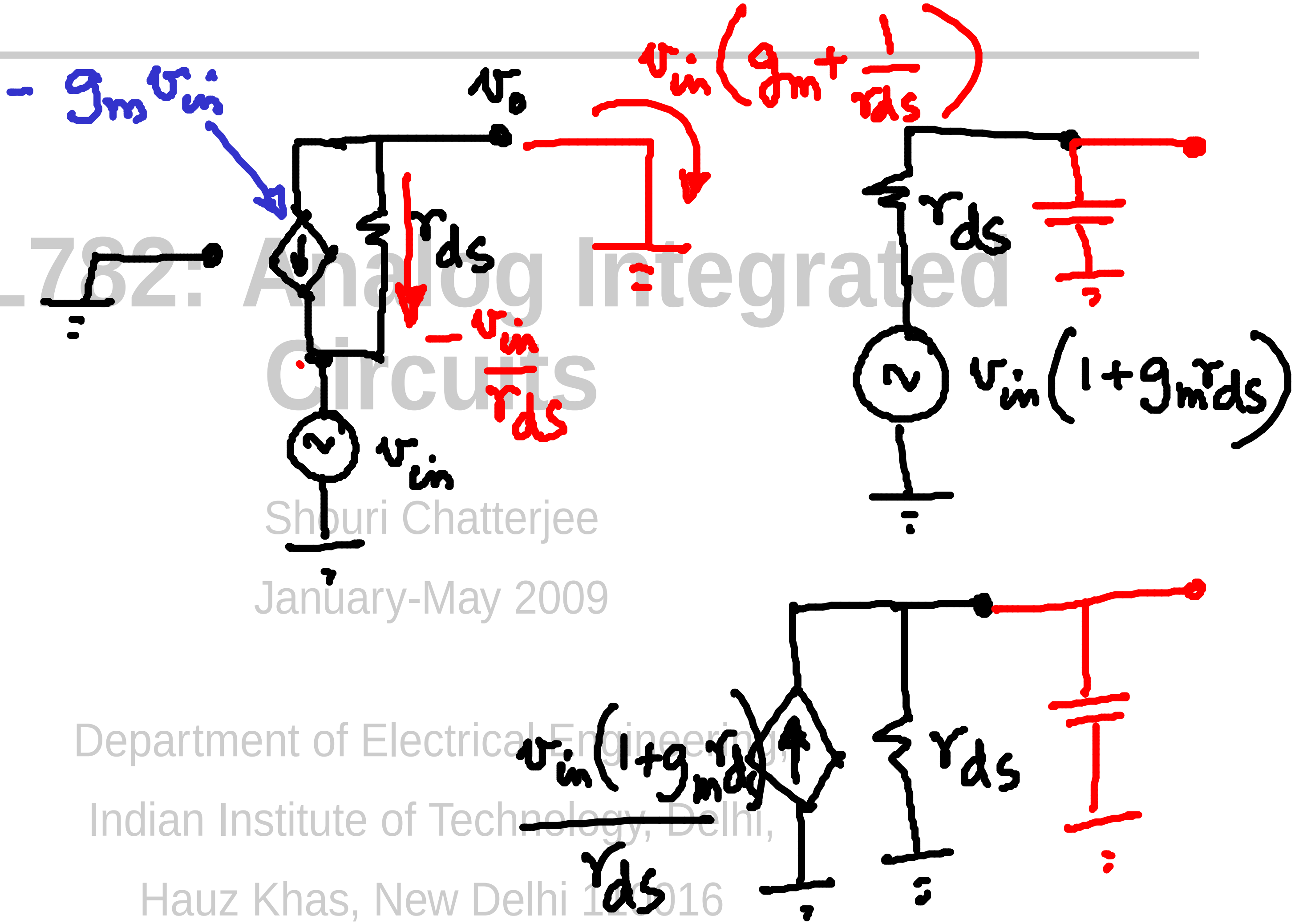
$$\frac{v_{out}}{v_{in}} = (1 + g_m r_{ds}) \cdot \frac{1}{1 + s r_{ds}(C_{gd} + C_{bd})}$$

EEL782: Analog Integrated Circuits

Shouri Chatterjee

January-May 2009

Department of Electrical Engineering,
Indian Institute of Technology, Delhi,
Hauz Khas, New Delhi 110016

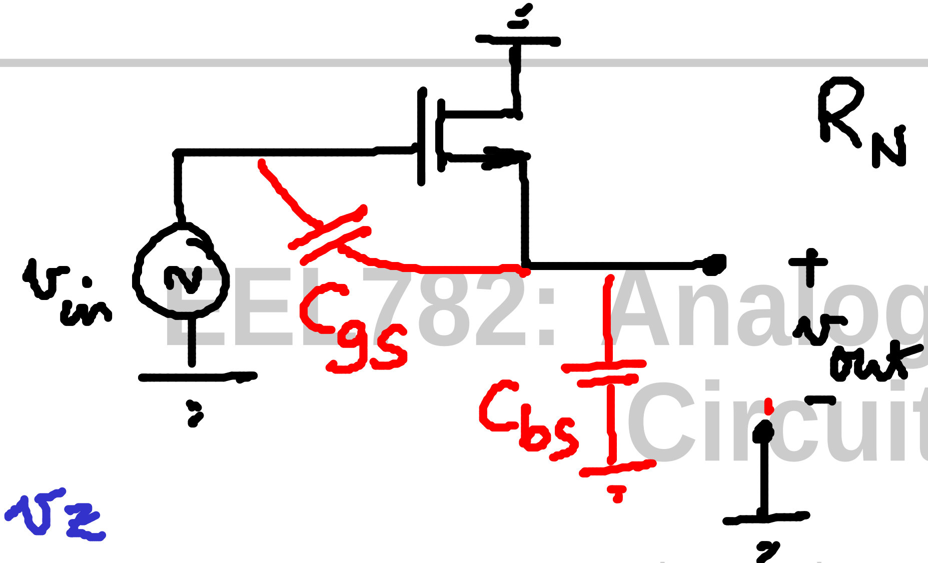


EEL782: Analog Integrated Circuits

Shouri Chatterjee

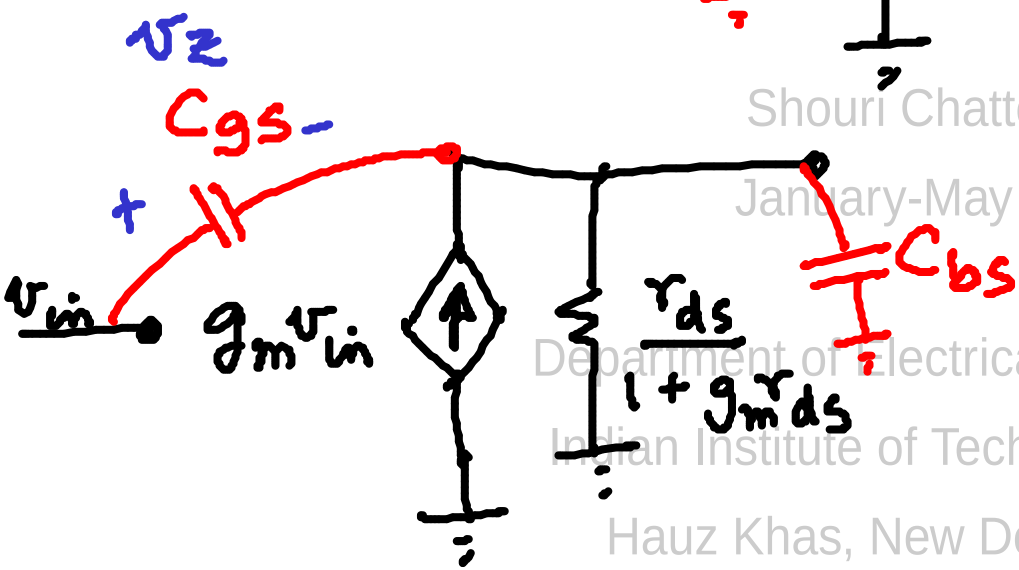
January-May 2009

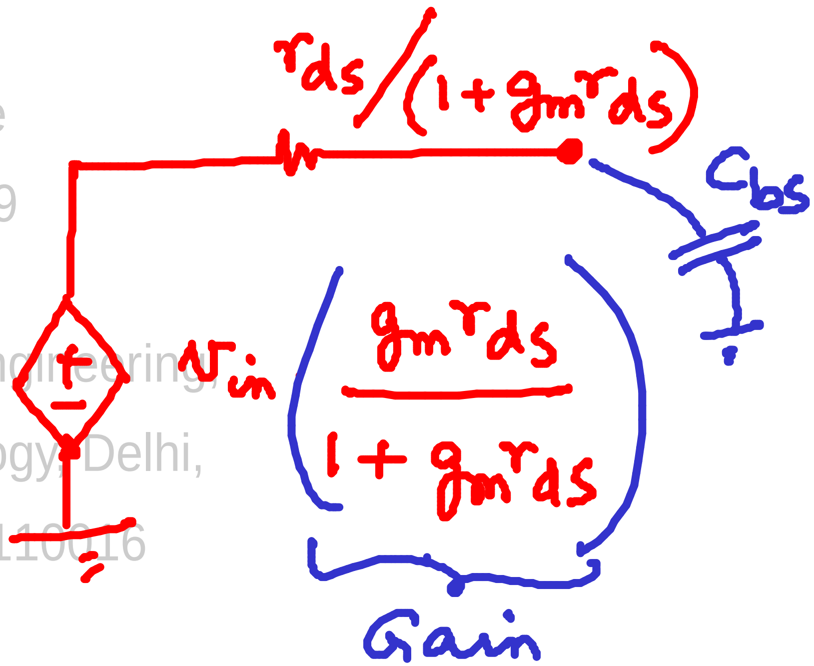
Department of Electrical Engineering,
Indian Institute of Technology Delhi,
Hauz Khas, New Delhi 110016



$$R_N = 1/g_m \,||\, r_{ds}$$

$$I_N = g_m v_{in}$$



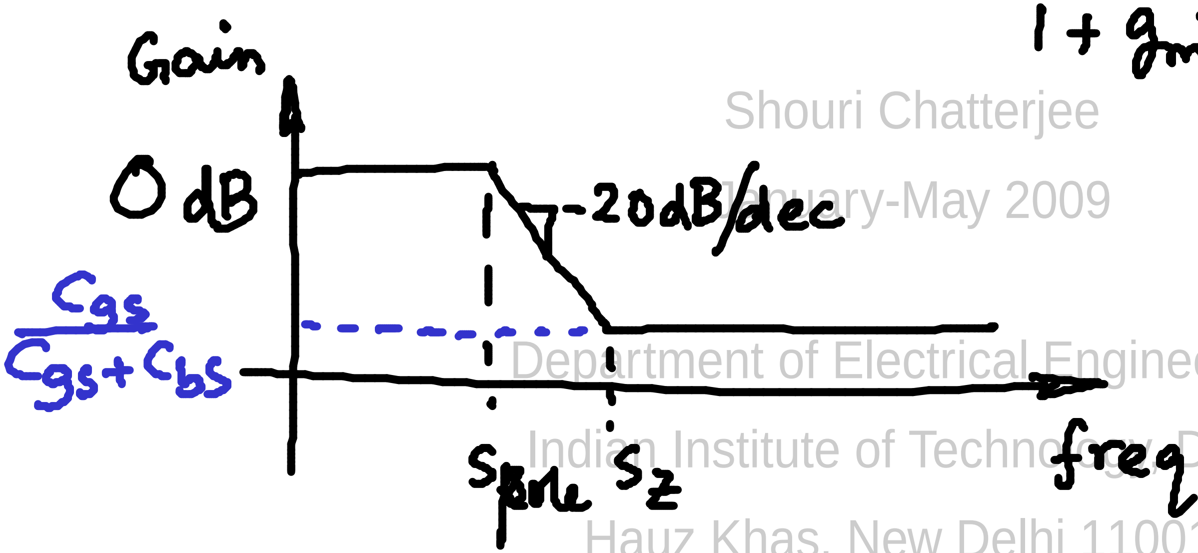


$$v_z \cdot s_z C_{gs} = -g_m v_z$$

$$s_z = -g_m/C_{gs}$$

$$s_{pole} = -\frac{1 + g_m r_{ds}}{(C_{gs} + C_{bs}) \cdot r_{ds}}$$

$$\frac{v_{out}}{v_{in}} = \left(\frac{g_m r_{ds}}{1 + g_m r_{ds}}\right) \left[\frac{1 + s\, C_{gs}/g_m}{1 + s \frac{(C_{gs} + C_{bs}) r_{ds}}{1 + g_m r_{ds}}} \right] \quad s \to \infty \quad \approx \frac{C_{gs}}{C_{gs} + C_{bs}}$$



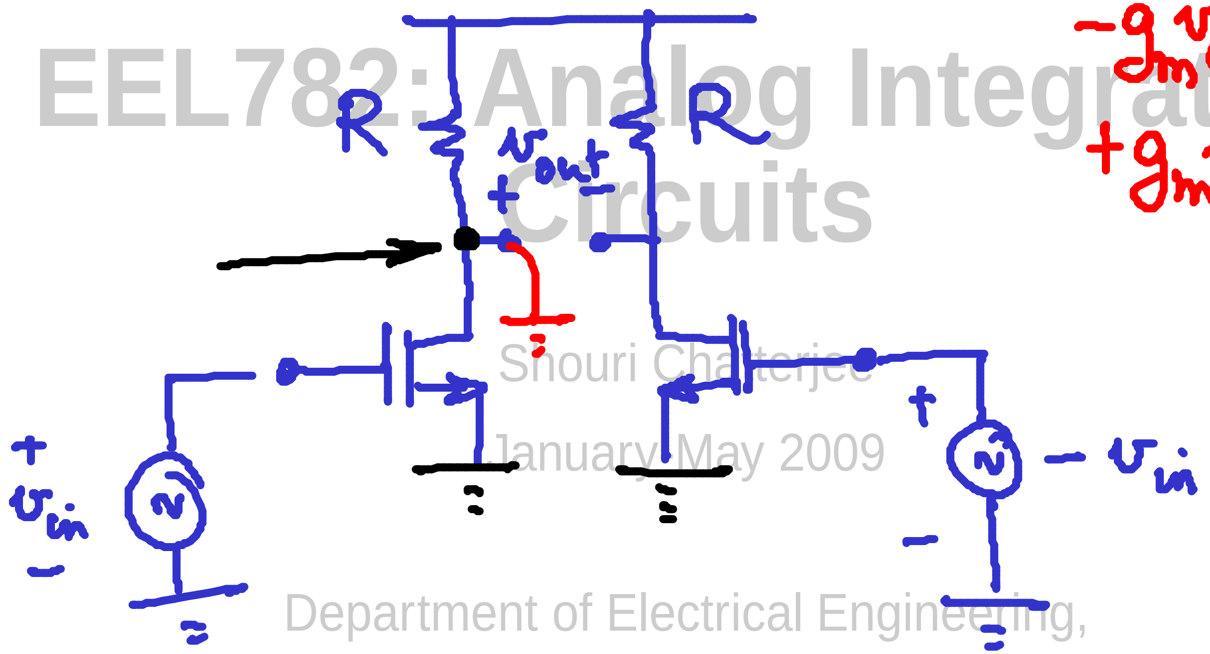
EEL782: Analog Integrated Circuits

Shouri Chatterjee

January-May 2009

Department of Electrical Engineering,
Indian Institute of Technology Delhi,
Hauz Khas, New Delhi 110016

Differential amplifier

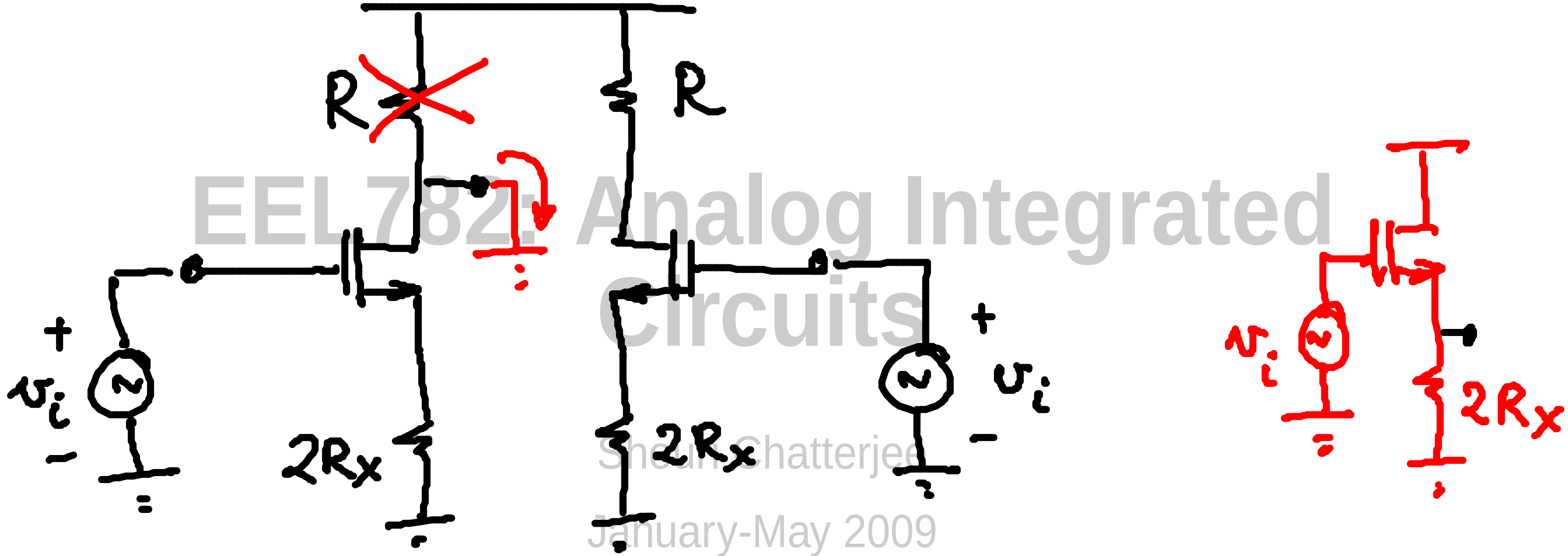


$$-g_m v_{in}(R\|r_{ds})$$

$$+g_m v_{in}(R\|r_{ds})$$

$$v_{out} = -2g_m v_{in}(R\|r_{ds})$$

EEL 782: Analog Integrated Circuits



Shouri Chatterjee

January-May 2009

$$R \,||\, (g_m r_{ds} 2R_x + r_{ds} + 2R_x)$$

Department of Electrical Engineering,
Indian Institute of Technology, Delhi,
Hauz Khas, New Delhi 110016