ELEG 309 - Example Problems Chapter 5-1

**Example 5.1**

Consider a process technology for which *L*min = 0.4 μm, *tox* = 8 nm, μ*n* = 450 cm2/V⋅s, and *Vt* = 0.7 V.

(a) Find *Cox* and .

(b) For a MOSFET with *W*/*L* = 8 m/0.8 m, calculate the values of *VOV*, *VGS*, and *VDS*min needed to operate the transistor in the saturation region with a dc current *ID* = 100 μA.

(c) For the device in (b), find the values of *VOV* and *VGS* required to cause the device to operate as a 1000  resistor for very small *vDS*.

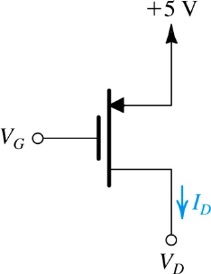
**Example 5.2**

Consider an NMOS transistor fabricated in a 0.18-μm process with *L* = 0.18 μm and *W* = 2 μm. The process technology is specified to have *Cox* = 8.6 fF/μm2, μ*n* = 450 cm2/V⋅s, and *Vtn* = 0.5 V.

(a) Find *VGS* and *VDS* that result in the MOSFET operating at the edge of saturation with *ID* = 100 μA.

(b) If *VGS* is kept constant, find *VDS* that results in *ID* = 50 μA.

(c) To investigate the use of the MOSFET as a linear amplifier, let it be operating in saturation with *VDS* = 0.3 V. Find the change in *iD* resulting from changing *vGS* from 0.7 V by +0.01 V and by -0.01 V.

**Exercise 5.7**

The PMOS transistor shown in Fig. E5.7 has *Vtp*=-1 V*,* = 60 A/V2, and *W/L* = 10.

(a) Find the range of *VG* for which the transistor conducts.

(b) In terms of *VG,* find the range of *VD* for which the transistor operates in the triode region.

(c) In terms of *VG,* find the range of *VD* for which the transistor operates in saturation.

(d) Neglecting channel-length modulation (i.e.,  *=*0*),* find the values of |*VOV* | and *VG* and the corresponding range of *VD* to operate the transistor in the saturation mode with *ID* = 75 A.

(e) If = -0.02 V-1*,* find the value of *ro* corresponding to the overdrive voltage determined in (d).

**Figure E5.7**

(f) For = -0.02 V-1 and for the value of *VOV* determined in (d), find *ID* at *VD =* +3 V and at *VD* = 0 V*;* hence, calculate the value of the apparent output resistance in saturation. Compare to the value found in (e).

**Problem 5.9**

An NMOS transistor with *kn* = 1 mA/V2and *Vt* = 1 V is operated with *VGS* = 2.5 V. At what value of *VDS* does the transistor enter the saturation region? What value of *ID is* obtained in saturation?