國立暨南國際大學 106 學年度碩士班入學考試試題   第 1 節

科目：電子學一(元件)   適用：電機系

編號：351

考生注意：
1.依次序作答，只要標明題號，不必抄題。
2.答案必須寫在答案卷上，否則不予計分。
3.限用藍、黑色筆作答；試題須隨卷繳回。

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1. Please define the following terms.
   (a) Depletion region (空乏區) of a diode (二極體)   (5 points)
   (b) Drift current (飄移電流)   (5 points)
   (c) Diffusion current (擴散電流)   (5 points)
   (d) N-type doping (N-型摻質)   (5 points)
   (e) P-type doping (P-型摻質)   (5 points)
   (f) Electron (電子)   (5 points)
   (g) Hole (電洞)   (5 points)
   (h) FET (場效電晶體)   (5 points)
   (i) BJT (雙載子電晶體)   (5 points)
   (j) CMOS Technology (互補式金氧半技術)   (5 points)

2. The drain-source current (I_{DS}) of an NMOS FET at small drain-source voltage (V_{DS}) is equal to $I_{DS} = \frac{1}{2}\mu_n C_{ox}\frac{W}{L}[2(V_{GS}-V_{TH})V_{DS}-V_{DS}^2]$. At small V_{DS}, the transistor can be viewed as a resistor (R_{on}), with the resistance depending on the gate-source voltage (V_{GS}). Prove R_{on} is equal to $R_{on} = \dfrac{1}{\mu_n C_{ox}\frac{W}{L}(V_{GS}-V_{TH})}$

   (20 points)

3. Fig. 1 shows the small-signal model including channel-length modulation of an NMOS FET operated in the saturation region. Prove the output resistance r_o and transconductance g_m can be represented as follows:

   (a) $r_o \approx \dfrac{1}{\lambda I_D}$ (15 points)

   (b) $g_m = \mu_n C_{ox}\dfrac{W}{L}(V_{GS}-V_{TH})$ (15 points)

Fig. 1