

系所組別：微電子工程研究所

考試科目：固態電子元件

考試日期：0226，節次：2

※ 考生請注意：本試題可使用計算機，並限「考選部核定之國家考試電子計算器」機型

1. (10%) (a) What mechanism(s) cause(s) current in a forward biased p-n junction? Draw the energy band diagram and indicate the direction of motion of majority and minority carriers.
(7%) (b) What is the drain induced barrier lowering effect and how does it affect the transistor characteristics?
2. (10%) (a) Explain why a bipolar junction transistor can have a current gain larger than one in the common emitter mode. Provide the necessary and sufficient conditions needed to obtain a current gain larger than one.
(7%) (b) Describe briefly the advantages of poly-silicon gate and metal gate technology, respectively.
3. (6%) (a) What is electron effective mass?
(7%) (b) Describe what cause or why the energy states splitting in single crystal material?
4. (20%) Consider an uniformly doped p-n junction with doping concentration of N_a and N_d , respectively. Assuming it is an abrupt junction (at $x=0$) and the space charge regions end at $-X_p$ and X_n , respectively, derive the electric fields in the space charge regions.
5. Consider the interface between GaN and air with the respective refractive indices of 2.399 and 1,
 - (a) (10%) What would be the corresponding critical angle?
 - (b) (5%) What would happen if the photon incident upon the interface at angle greater than the critical angle?
6. (18%) Calculate the thickness of silicon that will absorb 90% of the incident photon energy, assuming the incident wavelength is $1.0 \mu\text{m}$ and the corresponding absorption coefficient $\alpha \cong 10^2 \text{ cm}^{-1}$.