

國立臺灣科技大學

九十一學年度博士班招生考試試題

系所組別：電子工程系丙組

科目：半導體物理及元件

總分 100 分

- (1) Please roughly plot the temperature dependence of electron mobility in a doped Si sample. And why? (10%)
- (2) Please roughly plot the electron density as a function of temperature for a Si sample with a donor concentration of 10^{15} cm^{-2} (roughly three regions). And why? (15%)
- (3) For an one-side abrupt p-n junction, please derive that the depletion capacitance per unit area for the junction is given by $C_j = \epsilon_s/W$, where W is the depletion width and ϵ_s is the dielectric constant of semiconductor. And from the above C_j , please derive the equation available for obtaining N_D and V_{bi} , and also explain how to obtain them. (20%)
- (4) Please roughly plot the band diagram for a homo-junction bipolar transistor under active mode operation. And also explain how to improve γ (emitter injection efficiency) and α_T (base transport factor). (10%)
- (5) For a MOSFET, please qualitatively describe the following relations and explain why.
 - (a) threshold voltage versus $|V_{bs}|$ (5%)
 - (b) subthreshold swing versus $|V_{bs}|$ (5%)
 - (c) drain current versus gate voltage (7%)
 - (d) drain current versus drain voltage (under a proper V_{gs} bias) (8%)
- (6) Please roughly plot the common emitter current gain for a homo-junction BJT as a function of collector current, and why? (10%)
- (7) Please explain the "short channel effect" in a MOSFET. (10%)

