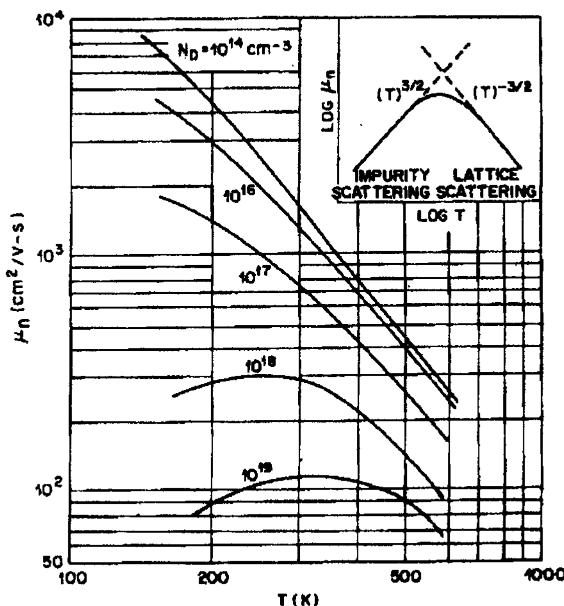
本試題是否可以使用計算機：☑可使用 ， □不可使用 （請命題老師勾選）

96 學年度 電機系 碩士在職專班 甲組 半導體概論 試題

1. A silicon ingot is doped with 10^{15} arsenic atomes/cm^3 at 300 K. Find the electron and hole concentrations, Fermi level and intrinsic Fermi level with respect to the conduction energy level E_C. Draw a simple energy diagram for the doped silicon.(15 分)

2. The following diagram is the measured electron mobility of silicon versus temperature for various donor concentrations. The insert shows the theoretical temperature dependence of electron mobility. Describe the major mechanisms that influence the behavior of electron mobility and what are the roles of temperature and donor concentration in these mechanisms. Why the total electron mobility can be expressed as $\frac{1}{\mu}=\frac{1}{\mu_L}+\frac{1}{\mu_I}$, where μ_L and μ_I represent the electron mobilities due to lattice scattering and impurity scattering, respectively.(20 分)



3. A 0.46-μm-thick sample of GaAs is illuminated with monochromatic light of $h\nu = 2$eV. The bandgap of GaAs is 1.43 eV and the absorption coefficient α is 5×10^4 cm^{-1}. The power incident on the sample is 10 mW. (15 分)
(a) Find the total energy absorbed by the sample per second.
(b) Find the rate of excess thermal energy given up by the electrons to the lattice before recombination (J/sec).
(c) Find the number of photons per second given off from recombination events.

（背面仍有題目,請繼續作答）

國立成功大學九十六學年度碩士班招生考試試題

編號： 263 系所：電機工程學系在職專班甲組 科目：半導體概論（專班）

本試題是否可以使用計算機： ☑可使用 ， ☐不可使用 （請命題老師勾選）

4. Please explain (a) short channel effects (b) the narrow channel effects of MOSFET device and how they affect the device characteristics. (15 分)

5. (a) Please describe the reason why we need to lower gate oxide thickness when device scaling down. (10分)
   (b) Please describe the key issues that you think might limit (block) the device scale-down. (10分)

6. Describe how the majority and minority carriers establish equilibrium when n and p type semiconductors bring to contact (or make junction). (15 分)

Some data may be useful for the examination:

At 300K, $kT = 0.0259$ eV, bandgap of Si = 1.12 eV, intrinsic carrier density of Si = 1.5×10^{10} cm^{-3}, dielectric constant of Si = 11.7, dielectric constant of SiO_2 = 3.9.

$\varepsilon_0 = 8.85\times10^{-14}$ F/cm

Measured ionization energies for various impurities in Si in unit of eV

E_C
Sb P As Tl C Pt Au O
0.039 0.045 0.054 0.21 0.25 0.25 A 0.16 0.38 A 0.51 0.54 A
0.34 0.35 D 0.36 0.3 D 0.29 D 0.41
0.045 0.067 0.072 0.16
E_V
B Al Ga In Pd