1. 請說明空乏型 (depletion mode)n-通道 (channel) 金屬-氧化物-半導體場效電晶體 (Metal-Oxide-Semiconductor Field-effect transistors, MOSFET)之工作原理，並繪出其電流電壓曲線圖(current-voltage characteristics)。　　　　　(15分)

2. 在 n-p-n 電晶體結構中，請說明在源極(Source)及汲極(Drain)兩接面中，若皆為異質接面 (Heterojunction)，其特性較皆為同質接面(Homojunction)有哪些電特性較優呢?其理由為何?　　　　　(15分)

3. 在金屬-半導體接觸(metal-semiconductor contact)的結構中，若半導體表面有因表面懸鍵 (Dangling bonds)所形成的表面狀態存在時，請說明其對金屬-半導體接觸之特性有何影響呢?　　　　　(10分)

4. 請說明如何利用電容-電壓測量法(capacitance-voltage measurement method)去測量半導體材料的載體(carrier)分佈曲線呢?其原理為何呢?　　　　　(10分)

（背面仍有題目，請繼續作答）

5. Explain or define the following terms. (10%)
   (a) Electron affinity.
   (b) Minority carriers.
   (c) Peltier effect.
   (d) Work function.
   (e) Avalanche breakdown.

6. (a) Determine the maximum value of the energy gap that a semiconductor, used as a photoconductor, can have if it is to be sensitive to yellow light (600 nm).
   (b) A photodetector whose area is 5×10^{-2} cm^2 is irradiated with yellow light whose intensity is 2 mW cm^{-2}. Assuming that each photon generates one electron-hole pair, calculate the number of pairs generated per second.
   (c) From the known energy gap of the semiconductor GaAs (E_g = 1.42 eV), calculate the primary wavelength of photons emitted from this crystal as a result of electron-hole recombination.
   (d) Is the above wavelength visible?
   (e) Will a silicon photodetector be sensitive to the radiation from a GaAs laser? Why?
   (20%)

7. A Si wafer ($n_i = 1.45 \times 10^{10}$ cm^{-3}) has been doped n-type with 10^{17} As atoms cm^{-3}.
   (a) Calculate the conductivity of the sample at 27 °C assuming that drift mobility $\mu_e \approx 800$ cm^2 V^{-1} s^{-1}.
   (b) Where is the Fermi level in this sample at 27 °C with respect to the Fermi level (E_{Fi}) in intrinsic Si?

   The above n-type Si sample is further doped with 9×10^{16} boron atoms (p-type dopant) per centimeter cubed.
   (c) Calculate the conductivity of the sample at 27 °C assuming that drift mobility $\mu_e \approx 600$ cm^2 V^{-1} s^{-1}.
   (d) Where is the Fermi level in this sample with respect to the Fermi level in the previous sample at 27 °C? Is this an n-type or p-type Si? (20%)