1. (25分) Please derive the ideal current-voltage relation in the nonsaturation and saturation region for the n-channel MOSFET.

2. (25 分) Please sketch the ideal energy-band diagrams (before and after **"ohmic"** contact) for (a) an ideal metal-to-n-type semiconductor junction, and (b) an ideal metal-to-p-type semiconductor junction. (please label the following terms: E_c, E_v, E_F, E_{Fi}, $e\phi_m$, $e\phi_n$, $e\phi_p$, $e\phi_s$, $e\phi_{Bn}$, ϕ_{Bp}, $e\chi$ .....)

3. (25 分) Explain the following items:
   (a) Fermi-Dirac distribution function
   (b) Phonon
   (c) Stimulated emission
   (d) Photovoltaic effect
   (e) Avalanche breakdown in junction diode

4. (25 分) (a) Plot the electron mobility versus temperature relation for typical n-type silicon, and explain why that ?
   (b) Plot the electron concentration versus temperature relation for typical n-type silicon, and explain why that ?