(25%) 1. Explain the following items:

(a) GRIN-SCH multiple-quantum-well laser structure.
(b) Float-zone process.
(c) High electron mobility transistor.
(d) Ideality factor.
(e) How p-type semiconductors could make Ohmic-contact junction with metals?

(25%) 2. Describe detailedly for the Haynes-Shockley experiment including:

(a) The experimental setup.
(b) How it works?

3. Semiconductor

(1). Which of the following statements are correct? (multiple choice) (5%)

(A). the conductivity of semiconductor increases with increasing temperature
(B). the conductivity of insulator increases with increasing temperature
(C). the conductivity of metal increases with increasing temperature
(D). the conductivity of semiconductor decreases with increasing temperature

4. What is the main function of the gate inside a field effect transistor? (multi-choice) (5%)

(A). Change the current between source and drain
(B). Change the current between source and gate
(C). Change the voltage between source and drain
(D). Ground the device
(E). None of the above, state your reason_____

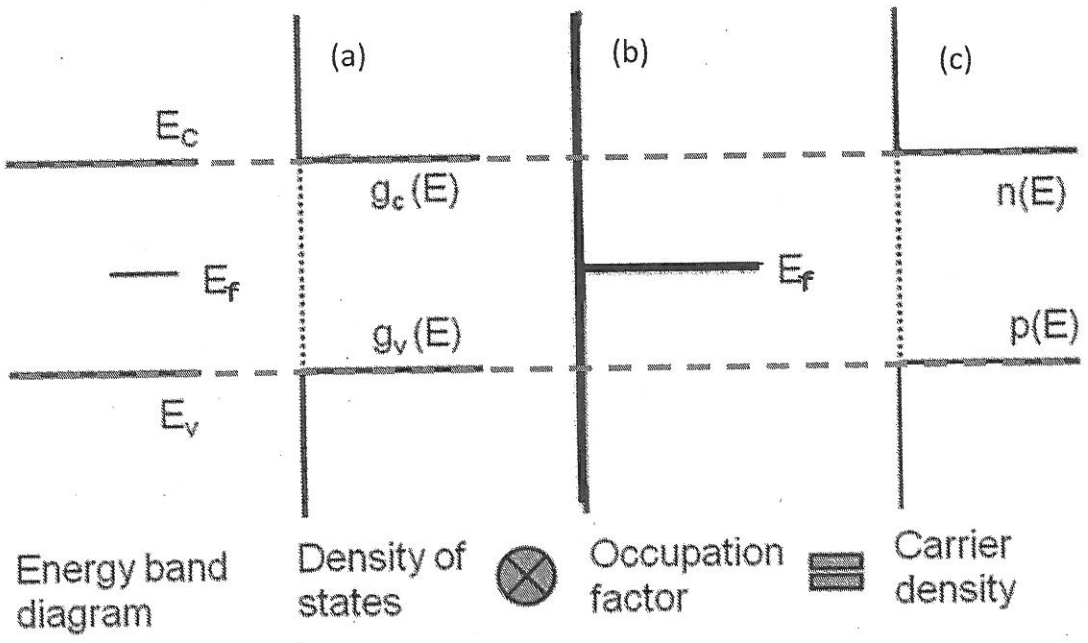
5. What do you tell if a metal electrode is schottky or ohmic to a semiconductor? when we put two identical metal electrode on a semiconductor and measure its current/voltage (I-V) behavior, what are we expecting? (multi-choice) (5%)

(A). When contact is Schottky, the I-V is linear
(B). When contact is Ohmic, the I-V is linear
(C). When contact is Ohmic, the current will exponential increase with voltage
(D). None of the above, state your reason_____

6. If a material(as illustration, D=W=0.1 cm, l=1cm) has conductivity of 0.1 $(\Omega cm)^{-1}$,

(1). What is its resistivity of this material?____(unit). (5%)

7. Given the semiconductor band diagram on the left hand side of the figure with Energy as the y-axis: Sketch (a) the density of state, (b) the Fermi distribution and the resulting (c) carrier density in this figure for a 3-dimensional material (5%)



8. Calculate the intrinsic carrier concentration in silicon at T=300K,(Hint kT=0.0259 eV, Eg=1.1 eV, plank constant= 6.626×10^{-34} m^2 kg/s, m_n^* =1.08m_0, m_p^*=0.56m_0,)
   Ans: _____ cm^{-3} (5%)
9. If the intrinsic carrier concentration of silicon is $1.5x10^{10}$ cm^3 , kT=0.026 eV, m_n^* =1.08m_0, m_p^*=0.56m_0, (10%)
   (1). Determine the E_{fi}-$E_{g/2}$= _____ eV (E_{fi}: intrinsic fermi level)
   (2). If this intrinsic silicon was doped with $N_d=10^{16}$ cm^3 , what will be the resulting hole concentration? _____ cm^3
10. Draw the voltage/current diagram of a resistor and a diode? (5%)

resistor	diode

11. How many photons does a 100 mW green light (532nm) laser generate within 1 second? (5%)_____