

University of Alberta
Department of Chemical and Materials Engineering

Lecturer: Dr. Stojan Djokić

MAT E 201
Materials Science I
Assignment No.8 (16 marks)

March 13, 2020

Due Date: March 20, 2020 by 3:00 pm

1. A current density of 2000 A/cm^2 is applied to a cobalt wire. If $2/3$ of the valence electrons serve as charge carriers, calculate the average drift velocity of electrons. **(3marks)**
2. Draw a schematic of the band structures of a dielectric, a semiconductor, and a metallic material. Use this to explain why the conductivity of pure metals decreases with increasing temperature, while the opposite is true for semiconductors and dielectrics. **(3 marks)**
3. Calculate the electrical conductivity of copper at -100°C and at $+500^\circ\text{C}$. **(3 marks)**
4. After finding the electrical conductivity of aluminum at 0°C , we decide to double this conductivity. To what temperature we must cool the metal? **(3 marks)**
5. The electrical resistivity of a beryllium alloy containing 7 at.% of an alloying element is found to be $70 \cdot 10^{-6} \text{ ohm cm}$ at 450°C . Determine the contributions to resistivity due to temperature and due to impurities by finding the expected resistivity of pure beryllium at 450°C , the resistivity due to impurities, and the defect resistivity coefficient. What would be the electrical resistivity if the beryllium contained 15 at.% of the alloying element at 250°C ? **(4marks)**