Question 1

(a) Compute the electrical conductivity of a 5.1 mm diameter cylindrical silicon specimen 51 mm long in which a current of 0.1 A passes in an axial direction. A voltage of 12.5 V is measured across two probes that are separated by 38 mm.
(b) Compute the resistance over the entire 51 mm of the specimen.

Question 2

Pure Germanium to which 5×10^{22} m^{-3} Sb atoms have been added is an extrinsic semiconductor at room temperature, and virtually all the Sb atoms may be thought of as being ionized (i.e., one charge carrier exists for each Sb atom). (a) Is this material n-type or p-type? (b) Calculate the electrical conductivity of this material, assuming electron and hole mobilities of 0.1 and 0.05 m^2/V-s, respectively.

Question 3

A copper wire is stretched elastically with a stress of 70 MPa at 20°C. If the length is held constant, to what temperature must the wire be changed to reduce the stress to 35 MPa?

Question 4

Considering the thermal shock resistant parameter (TSR) equation (below), what measures may be taken to reduce the likelihood of thermal shock of a ceramic piece?

$$TSR \cong \frac{\sigma_f k}{E \alpha_l}$$

Question 5

Zinc selenide (ZnSe) has a band gap of 2.58 eV. Over what range of wavelengths of visible light is it transparent?