Centre For Energy Studies

Major - Part A

M.M: 20

ESL- 730 Direct Energy Conversion

1.(a) Explain degenerate semiconductor with the help of energy level diagram. (1)

(b) Show that for a semiconductor the ratio of maximum to intrinsic resistivities is given by

$$\frac{\rho_{max}}{\rho_i} = \frac{(\mu_n + \mu_p)}{2(\mu_n \mu_p)^{1/2}}$$

where the symbols have their standard meanings. Assuming $\mu_n = 3\mu_p$. Solve for the doping levels which result in ρ_{max} (8)

(2) a) Draw the voltage - current characteristics of fuel cells. (1)

(b) Drive the following relations for fuel cell

$$\Delta S = nF\left(\frac{\delta E}{\partial T}\right)_p, \quad T\left(\frac{\delta E}{\delta T}\right)_p = \frac{\Delta H}{nF} + E$$ (2)

(c) A galvanic cell has the following reaction,

$$Ag(s) + HgCl(s) = AgCl(s) + Hg(l)$$

if $E^{\circ}_{25^{\circ}C} = 0.0455$ Volt, and $(\delta E^{\circ}/\delta T) = 0.00338$ Volt/degree, calculate ΔG and ΔH, for the following values: (2)

$n = 1$, $F = 96500$, $T = 298^{\circ}K$

3.(a) Calculate the wave length of light capable of forming an electron hole pair in silicon. For silicon, band gap of 1.11 eV and $h = 6.625 \times 10^{-34}$ J.Sec (2)

(b) The dark current density for a silicon solar cell at 40°C is 1.8×10^{-8} A/m², short circuit current density is 200 A/m² open circuit voltage 0.624 V, voltage at maximum power 0.542 V, Current density at maximum power 190.5 A/m². Calculate;

(i) Maximum power

(ii) Maximum efficiency

(iii) The cell area required for an output of 25 W when exposed to solar radiation of 900 W/m². (3)

(c) write name of two materials which work as Anti-reflection (AR) coatings. (1)