

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

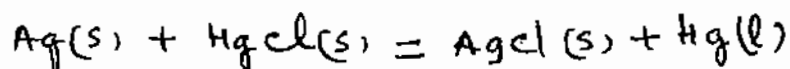
levels which result in ρ_{\max} (8)

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

(b) Derive the following relations for fuel cell

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

(c) A galvanic cell has the following reaction,



if $E_{25^\circ}^\circ = 0.0455 \text{ Volt}$, and $\left(\frac{\delta E^\circ}{\delta T} \right) = 0.000338 \text{ Volt/degree}$, calculate ΔG and ΔH for the following values:

$n=1$, $F=96500$, $T=298^\circ \text{K}$ (2)

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

$$h = 6.625 \times 10^{-34} \text{ J} \cdot \text{Sec}$$

(2)

The dark current density
(b) for a Silicon Solar Cell at 40°C is 1.8×10^{-8}

A/m^2 , short circuit current density is 200 A/m^2

open circuit voltage 0.624 V , voltage at

maximum power 0.542 V , Current density

at maximum power 190.5 A/m^2 , 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/m^2 . (3)

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