EPV 453 MINOR 2 SEMESTER II 2014 – 15 19 March 2015

Time: 1 hr M. Marks: 40

Note: Energy band diagram and sketches should be made neatly with appropriate proportions and labeling to get credit. **Justifications should be brief and point-wise.**

1. Consider a single p-n junction solar cell. Give the five fundamental reasons (with brief justification for each) that limit the conversion efficiency of such a solar cell.

(2x5)

2. Consider a multi p-n junction solar cell. **(a)** Sketch the basic structure of a 3 junction cell and briefly discuss how we get higher conversion efficiency and lower energy losses related to excited photo carriers. **(b)** Justify the need of tunnel junction for inter-connect between the sub-cells. **(c)** How does the concept of metamorphic growth overcome the problem of lattice mismatch related dislocations?

(6+2+2)

3. Briefly describe the concept/working principle behind efficiency enhancement by **(a)** higher photon absorption in thin absorber solar cell; **(b)** decreasing top surface reflection by texturing; **(c)** coupling more light by use of metal nano-particles; and (d) use of intermediate band.

(3+2+3+2)

4. Make sketches of **(a)** Spectral irradiance vs wavelength for AM 1.5 solar spectrum; **(b)** Photon flux vs photon energy in solar spectrum; **(c)** Efficiency vs number of junctions in tandem solar cell; **(d)** E_{G1} vs E_{G2} in a double junction solar cell for getting highest conversion efficiency; and **(e)** Energy-band structure of tunnel junction for acting as interconnect.

(2x5)

1). Bandgap.

2). Single e-h pair generation / photon

3). Non-radiative recombination

4). Spectral losses

5). Limited Mobility.