ESE 3207 ➔ Solar Photovoltaic System ➔ Credit: 3.00 ➔ Contact hour: 3hrs/week

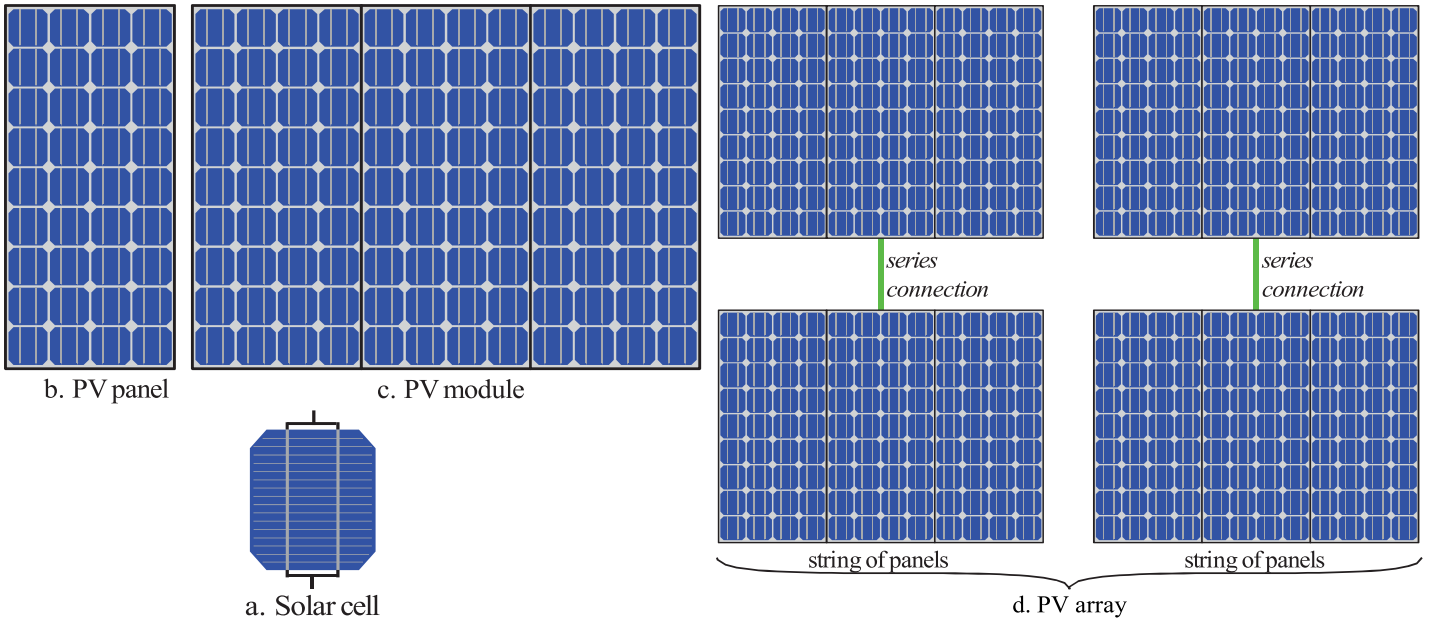
Introduction: PV physics, band structure and Fermi level in semiconductors, pn-junctions, diode models, photon interactions with semiconductors.

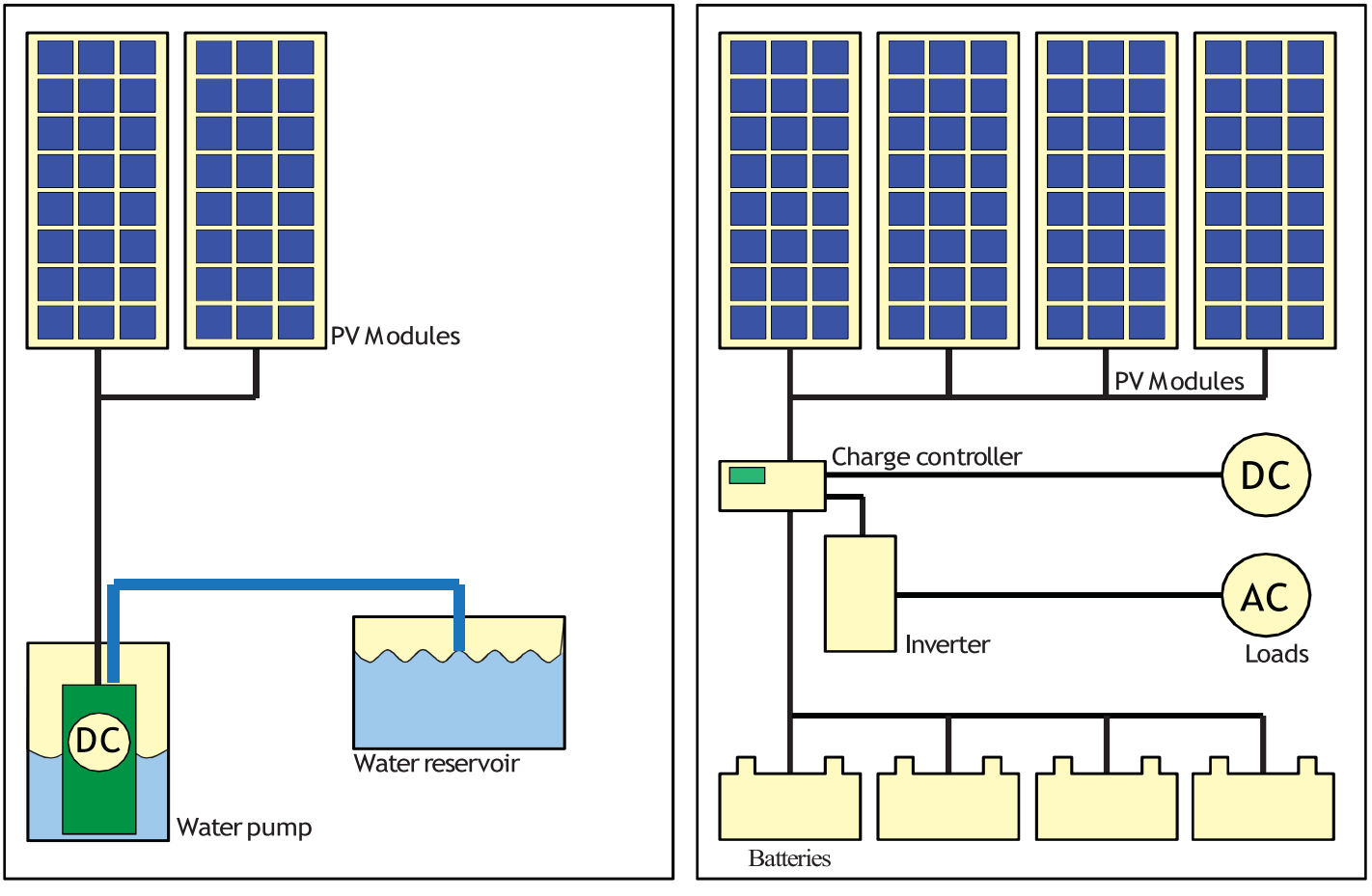
PV Cell Fundamentals: Working principle, Computing PV cell power, equivalent circuit models, short- and opencircuit properties, fill factor, and parasitic resistances. PV cell external and internal quantum efficiency, and computing the spectral response. Theoretical cell efficiency, multi-junction devices, the Shockley-Queisser limit. Antireflection coatings, cell passivation, and cell optical properties.

PV Technology: PV cell architecture and fabrication steps, characterization techniques crystalline Si substrates, thin film deposition, amorphous Si, CIGS, and CdTe thin-film cells.

PV Systems: Introduction to PV systems, Location and orientation issues, factor affecting performance, PV cells wired in series and parallel, shaded and faulty cell effects, Components of PV systems, system integration- online and offline, inverters, design criteria, calculation, economics and ecology of PV system, load analysis, life cycle analysis and cost estimation.

Ref Book ➔ Solar energy: The physics and engineering of photovoltaic conversion, technologies and systemsn by Arno HM Smets, Delft University of Technology, NL





Part I - The Solar

Part II - The PV Fundamentals by Mostafizur Rahaman, Lecturer, ESE, KUET

Chapter 1 - Materials: The Observation (6)

1.1 Metal	✖
1.2 Semi-Conductor	Intrinsic, Extrinsic Semiconductor
1.3 Insulator	✖

Chapter 2 - Materials: The Carrier (7)

2.1 Carrier Generation	Direct Radiant Types Carrier Generation, Indirect Non Radiant Type Carrier Generation
2.2 Carrier Recombination	Bulk Carrier Recombination, Surface Carrier Recombination

Chapter 3 - Materials: The Junction (8)

3.1 SS Junction	Binary Junction, Ternary Junction
3.2 MS/SM Junction	Mn(Schottky), mnN(Ohmic), mP(Schottky), Mp(Ohmic)
3.3 MM Junction	✖

Chapter 4 - Solar Cell: The Performance Parameters (9)

4.1 Internal Performance Parameters	✖
4.2 External Performance Parameters	$V_{OC}, I_{SC}, FF, \eta, \eta_{quan}$

Chapter 5 - Solar Cell : The Losses and Efficiency Limit(10)

5.1 Solar Cell Losses	Optical Losses, Electrical Losses
5.2 Solar Cell Efficiency Limit	$\eta = \frac{\int_0^{\lambda_G} \frac{hc}{\lambda}\phi_{ph,\lambda}d\lambda}{\int_0^{\infty} \frac{hc}{\lambda}\phi_{ph,\lambda}d\lambda} \times \frac{E_G \int_0^{\lambda_G} \phi_{ph,\lambda}d\lambda}{\int_0^{\lambda_G} \frac{hc}{\lambda}\phi_{ph,\lambda}d\lambda} \times (1-R^{`}) \times IQE_{op}^{`}\eta_G^{`} \times IQE_{el}^{`} \times \frac{A_f}{A_{tot}} \times \frac{eV_{oc}}{E_G} \times FF$

Part III - The PV Technologies by Mostafizur Rahaman, Lecturer, ESE, KUET

Chapter 1 - First Generation Solar Cell (12)

1.1 Mono Crystalline SC	c-Si Material Solar Cell
1.2 Multi/Poly Crystalline SC	multi-Si Material Solar Cell

Chapter 2 - Second Generation (Thin Film) Solar Cell (13)

2.1 Inorganic Compound Solar Cell	Amorphous MSC, Nano/Micro-crystalline MSC, III-V MSC, (II-VI, I-III-VI, I_2-II-IV-VI_4) MSC
2.2 Organic Compound Solar Cell	Organic Compound Solar Cell
2.3 Hybrid Solar Cell	Dye-sensitized solar cells, Perovskite solar cells

Chapter 3 - Third Generation Solar Cell (16)

3.1 Multi-junction solar cells	Multi-junction solar cells
3.2 Spectral conversion (up, down)	Spectral conversion (up, down)
3.3 Multi-exciton generation	Multi-exciton generation
3.4 Intermediate band solar cell	Intermediate band solar cell
3.5 Hot carrier solar cell	Hot carrier solar cell
3.6 Concentrator Solar Cell	Concentrator Solar Cell

Part IV - The PV System