

End Semester Examination, Nov-2023		
National Institute of Technology, Hamirpur		
Department of Physics & Photonics Science		
Program : B.Tech. Engineering Physics	Semester : 7	
Course code : PH-451	Course Title : Solar Photovoltaic	
Max. Marks : 50	Max time allowed : 3 hrs	
Q.No.	Questions	Marks
1	a) Explain the terms: solar irradiation and irradiance? b) Can a photon of wavelength 900 nm get absorbed in the Ga-As. Justify? c) Consider five solar cells are connected in series. Each of them has different short circuit current but same open circuit voltage. How will the short circuit current of the combination is determined. d) How the Solar grade-Si differs from EGS and MGS? e) What is directional solidification? f) Why the multi junction Ga-As solar-cells are preferred over the single junction Ga-As in concentrator PV system. g) What does the Staebler-Wronski effect describe? h) Compare the various methods of wafer dicing in terms of Kerf loss. i) List the materials used as buffer layer and window layer in CdTe solar cells. j) Explain the role of TCO layer in solar cell technologies	10
2.	What are the hot spots and how they affect the solar panels? Discuss the role of bypass diode and blocking diode in a PV module.	5
3.	Explain the following techniques of thin film deposition: i) DC sputtering, ii) low pressure CVD, and iii) ion assisted deposition.	5
4.	Compare the a-Si:H, CdTe, and CIGS thin-film solar cells on the basis of energy band diagram, solar cell structure, fabrication method, and efficiency.	5
5.	What is the difference between the diffusion length and drift length. An intrinsic hydrogenated amorphous Si layer in P-i-N structure has a electron mobility of $15 \text{ cm}^2/\text{Vs}$, rate of electron-hole pair generation under illumination is $5 \times 10^{19} \text{ cm}^{-3} \text{ s}^{-1}$, and photo conductivity is $1.2 \times 10^{-6}/\Omega \text{ cm}$. Compare the diffusion length and drift length in the Si-layer if electric field in the intrinsic layer is $1 \times 10^3 \text{ V/cm}$?	5
6.	Calculate the open circuit voltage V_{oc} , short circuit current I_{sc} and the series resistance of a solar cell when operating at the concentration ratio of 5-suns. Consider the short circuit current density at 1-sun is 40 mA/cm^2 and reverse saturation current density is $1.2 \times 10^{-12} \text{ A/cm}^2$. The cell area is 100 cm^2 operating at room temperature.	5
7.	What is the role of batteries for a PV system? Discuss the lead-acid and nickel-cadmium batteries in a PV system.	5
8.	Explain the tracking requirement of a concentrator PV. Explain the solar swing? A compound parabolic collector installed collects solar radiation for the 6 hrs, without tracking adjustment on 21 November. Calculate the solar swing angle, acceptance angle, and minimum concentration ratio.	5
9	a) Discuss the types of concentrator PVs on the basis of concentration ratio. b) The absorption coefficient of the 600nm photons in a semiconductor is 10^4 cm^{-1} . What is the maximum distance the photons would travel in a semiconductor before being absorbed?	5