Reg. No.



## MANIPAL INSTITUTE OF TECHNOLOGY MANIPAL

(A constituent unit of MAHE, Manipal)

## V SEMESTER B.TECH ONLINE EXAMINATIONS JANUARY-FEBRUARY 2021

## SOLAR PHOTOVOLTAICS [ELE 4304] (OPEN ELECTIVE)

REVISED CREDIT SYSTEM

Time: 3 H	ours	Date: 06/02/2021	Max. Marks: 50
Instruction	ns to Candidates:		
*	Answer <b>ALL</b> the questions.		
*	Missing data may be suitably as	sumed.	

- 1A. Calculate the declination angle, local apparent time for a collector parallel to ground pointing due south on November 1 located in Delhi (28.70 N, 77.10 E) at 11 AM. Calculate the day length and the hour angle if angle of incidence is given as 40°.
- **1B.** What will be the ratio of the direct radiation falling on a horizontal surface and a tilted surface facing south in Pune (18.52 N, 73.85 E) on January 1<sup>st</sup>, 12.00 PM. The inclination angle of the collector is equal to the latitude angle of the location.
- **2A.** I-V curves of two solar cells are given in Fig. What will be the Isc and Voc of the cells (a) if they are connected in series (b) if they are connected in parallel?. Assume that each section on the x-axis and y-axis as one unit of voltage and current, respectively.



**2B.** Doping levels at the P-side and N-side of the Si P-N junction are  $1 \times 10^{15}$ A atoms/cm<sup>3</sup> and  $1 \times 10^{15}$  B atoms/cm<sup>3</sup>, respectively. Calculate the open circuit voltage and short circuit current of the solar cell if the rate of carrier injection across the entire volume of diode is  $1 \times 10^{22}$ atoms/cm<sup>3</sup>/s, the electron and hole minority carrier diffusion lengths are 3 µm and 1 µm, respectively. Assume reverse saturation current density =  $3.15 \times 10^{-10}$  A/cm<sup>2</sup>. (05)

(06)

(04)

(05)

- 3A. A solar PV module has a rated power of 75 Wp. The nominal operating temperature of the module at a given location was found to be 48°C. Find the module temperature at NOC. What will be the rated power of the module at NOC. What will be the effect of this temperature on power output of the module.
- 3B. Five solar cells are connected in series. Each of them has different short circuit current. How will the short circuit current of the combination be determined?
- 4A. What is C-rating? A battery is rated as 100 Ah at 5C. Will the available capacity be different if it is discharged at 1C? Explain. (05)
- **4B**. The relationship between the output voltage and the current for a PV array is defined by the data given in the table. The PV array is connected to a resistive load  $R_1$  of 30  $\Omega$  through a boost converter operating in continuous mode. Determine the duty cycle of the interfacing converter required to operate the PV array at a voltage of 28.08 V.

Vpv(volts)	27.86	27.91	27.97	28.02	28.08	28.13	28.18	28.24	28.29	28.35	
Ipv(Amps)	1.76	1.73	1.71	1.69	1.67	1.64	1.62	1.59	1.57	1.54	(

- 5)
- 5A. How to realize voltage scaling algorithm for MPPT in a standalone PV power system.
- Can we connect PV array directly to battery? Justify you answer. 5B.

(05)

(05)