Name: **Enrolment No:**	

UPES

End Semester Examination, December 2023

Programme Name: M Tech Renewable **Semester : I**

Course Name : Optimization of Renewable Energy Systems **Time : 3 hrs.**

Course Code : EPEC7056 **Max. Marks: 100**

Nos. of page(s) : 2

Instructions: Assume the values of parameters logically where necessary

SECTION A
(4Qx5M=20Marks)

S. No.		Marks	CO
Q1	Define Energy and watt. What is Ohm's law and describe the associated terms?	**2 + 3 = 5**	**CO1**
Q2	What is a fuel cell? Why is it termed as "fuel cell"?	**2+3=5**	**CO1**
Q3	Discuss the principles of using semiconductors for solar cells.	**5**	**CO1**
Q4	Explain the cut-in and cut-out wind velocity with respect to the operation of wind turbine	**5**	**CO1**
	SECTION B **(4Qx10M= 40 Marks)**		
Q5	Discuss the anode and cathode side reactions for 1) H_2/O_2 fuel cell 2) Molten carbonate fuel cell (a) When fuel is H_2 (b) When fuel is CO	**5+5= 10**	**CO2**
Q6	Calculate the power converted from a wind machine at wind speed 12 m/s, air density 1.23 kg/m^3, and power coefficient is 0.4. The blade length of wind machine is about 52 m.	**10**	**CO2**
Q7	Find all local optima of the function. $f(x) = x^{\frac{1}{3}}(x-1)$	**10**	**CO3**
Q8	Assuming that the average daily solar radiation at a particular place is 600 W/m^2. Calculate the size of array with 30% efficient solar cells to produce 2 kW power.	**10**	**CO3**
	SECTION-C **(2Qx20M=40 Marks)**		
Q9	Air is to be compressed from 1 to 10 atm. pressure in a two-stage compressor. To increase the compression efficiency, the compressed air from the first stage of compression is cooled (it is passed through a heat exchanger) before entering the second stage of compression. For	**20**	**CO4**

	isentropic compression of air, the total work input to a compressor (W) can be represented by $W = c_p T_1 \left[\left(\frac{p_2}{p_1} \right)^{(k-1)/k} + \left(\frac{p_3}{p_2} \right)^{(k-1)/k} - 2 \right]$ where the specific heat of air at constant pressure is c_p = 1.006 kJ/kg. K, k = 1.4 is the ratio of specific heat at constant pressure to specific heat at constant volume of air, and the entering gas temperature T_1= 300K. Find the intermediate pressure p_2 at which cooling is required to minimize the work input to the compressor. Also, calculate the minimum work required to operate the compressor. Use search method with accelerated step size. Starting point = 1.0 (as the inlet pressure is 1 atm.) and initial step size = 0.05.		
Q10	Apply the fundamentals of kinetic energy to prove Betz power coefficient = 0.593 in case of wind turbine.	**20**	**CO4**