

Centre for Energy Studies, Indian Institute of Technology Delhi
ESN 751: Renewable Energy Resource Assessment and Forecasting (I Semester, 2020-21)

Time: One Hour

Minor Test

Maximum Marks: 25

Note: Please answer all questions in legible handwriting. The maximum marks assigned to a question are indicated at the end of the question within square brackets. In case, any required details appear to be missing in numerical questions, please make a suitable assumption and explicitly mention the same in the response to the question. Only a scientific calculator and a dictionary to translate English into the language of your preference and vice versa are allowed. Few formulae are given at the end of the question paper.

1. Operating temperature of the parabolic trough collector is ranging from

[1]

- (a) 40 to 80°C (b) 80 to 120°C (c) 100 to 150°C
 (d) 150 to 400°C (e) 400 to 800°C

2. Renewable energy forecasting is important to..... [1]

- (a) Identify the site selection (b) Schedule the operation strategy of a power plant
 (c) Reduce imbalance between the demand and supply (d) both (a) and (b)
 (e) Both (b) and (c) (f) All of the above

3. Example of a N-Type material is..... [1]

- (a) Boron (b) Antimony (c) Aluminum (d) Gallium

4. Match the hydropower plants mentioned in the second column with a corresponding plant capacity in the third column [2]

S. No.	Hydro Power Plants	Plant Capacity
a)	Pico Hydro	5 kW to 100 kW
b)	Micro Hydro	100 kW to 20 MW
c)	Small Hydro	> 20 MW
d)	Large Hydro	< 5 kW
		< 1 kW
		1 kW to 50 kW
		50 kW to 20 kW

5. Match the length scale mentioned in the second column with a corresponding phenomenon in the third column [2]

S. No.	Length Scale	Phenomenon
a)	Dissipation	High and low pressure systems
b)	Micro Scale	Wind flow pattern
c)	Meso Scale	Small cumulus
d)	Large Scale	Thunderstorms
		Local convection

6. Explain why (**Any two**): [3]
- Utility scale wind turbines have usually three blades?
 - Temperature of the atmosphere increases with altitude in the stratosphere?
 - Numerical weather prediction models have inherent biases?

7. Explain the differences between (**Any two**): [3]
- What is the difference between the tidal and wave energy
 - Hadley and Ferrel cell
 - Nudging and Ensemble Kalman Filter in data assimilation

8. At what wind speed the available power density in the wind would be equivalent to Solar Constant? The density of air is considered as 1.226 kg/m^3 . [2]

9. In the troposphere, the cloud coverage (C) is parameterized based on the relative humidity (RH) in air and it is given below:

$$C = 0 \quad \text{for } RH \leq RH_f$$

$$C = \left[\frac{(RH - RH_f)}{(1 - RH_f)} \right]^2 \quad \text{for } RH_f \leq RH < 1$$

$$C = 1 \quad \text{for } RH = 1$$

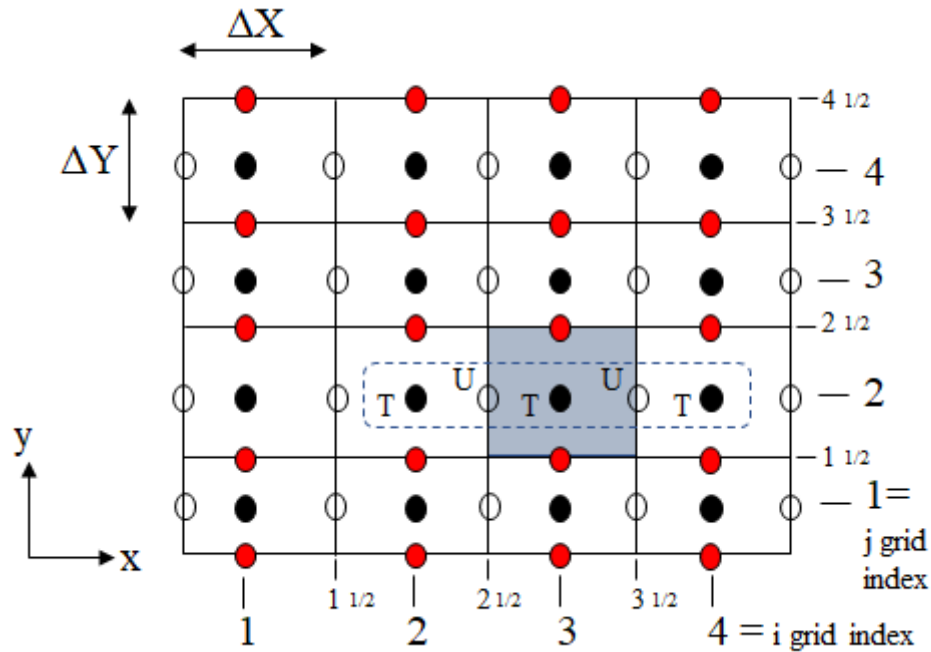
Calculate the cloud coverage with 0.1 intervals of relative humidity (RH). The formation of the cloud starts when the relative humidity (RH_f) is 0.5. [3]

10. The set of past observed and forecasted atmosphere temperatures are given in Table 1. Find the model with the best fit for a straight line profile and if the atmosphere temperature prediction for November 11, 2020 is 15°C . Estimate the corrected atmosphere temperature. [4]

Table 1. Forecasted and observed temperature of the atmosphere

S. No.	Observed Temperature ($^\circ\text{C}$)	Forecasted Temperature ($^\circ\text{C}$)
a)	-7.8	-6
b)	-6.7	-7
c)	-8	-8.5
d)	-5.7	-5
e)	-5.4	-5.8
f)	3.2	2
g)	5.5	4
h)	6.8	8
i)	11.1	12
j)	12.3	11.5

11. Calculate the rate of change of temperature due to temperature advection in the x -direction at grid point ($i = 3, j = 2$) as shown in below Figure 1. The temperature and velocity at various grid points are given as $T_{2,2} = 28^\circ\text{C}$, $T_{3,2} = 29.5^\circ\text{C}$, $T_{4,2} = 31^\circ\text{C}$, and $U_{2\frac{1}{2},2} = 5 \text{ m/s}$, $U_{3\frac{1}{2},2} = 8 \text{ m/s}$ respectively. Assume the distance between two points ($\Delta X, \Delta Y$) is given as 5 km. [3]



Formulae:

The coefficient of linear equations: $a_0 = \frac{(\bar{x}) \cdot (\overline{xy}) - \bar{x}^2 \cdot (\bar{y})}{(\bar{x})^2 - \bar{x}^2}$, $a_1 = \frac{(\bar{x}) \cdot (\bar{y}) - \overline{xy}}{(\bar{x})^2 - \bar{x}^2}$