

**INTRODUCTION TO SOLAR AND WIND TECHNOLOGY
(CHEN 4222)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

Candidates are required to give answer in their own words as far as practicable.

**Group - A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) The statement that maximum wavelength of radiation is inversely proportional to the temperature is
(a) Stefan-Boltzmann law (b) Plank's distribution law
(c) Wien's displacement law (d) Kirchhoff's law of thermal radiation.
 - (ii) The region where the electrons and holes diffused across the junction is called
(a) depletion Junction (b) depletion region
(c) depletion space (d) depletion boundary.
 - (iii) At north pole on 21st June the sunset hour angle is
(a) -90° (b) 180° (c) 90° (d) -180°.
 - (iv) How much power does the small-scale wind machine generate?
(a) 18 kW (b) 2 kW (c) 12 kW (d) 30 kW.
 - (v) What is the diameter of wind turbine blades?
(a) 320 feet (b) 220 feet (c) 80 feet (d) 500 feet.
 - (vi) Silicon solar cell efficiency is about
(a) 15% (b) 30% (c) 45% (d) 60%.
 - (vii) The azimuthal angle of a solar collector that faces east is
(a) 0° (b) 90° (c) -90° (d) 180°.
 - (viii) A single solar cell can produce a voltage of
(a) 1v (b) 0.1v (c) 0.5v (d) 0.05v.
 - (ix) How much total energy available in the wind over the earth surface?
(a) 1.6×10^7 MW (b) 5 MW (c) 2.9×10^7 MW (d) 1 MW.
 - (x) Wind speed is measure by using _____ Instrument
(a) Manometer (b) Pyranometer (c) Anemometer (d) Orifice.

Group - B

2. (a) What is view factor between two absorbing emitting medium in site of each other? [(CO1)(Understand/LOCQ)]
- (b) Define Solar Constant. Assuming the Sun is a black body of temperature 5760 K determine the solar constant at Mars with the help of the following given data. Diameter of sun = 1.39×10^9 m, Average distance between Sun and Mars = 2.15×10^{11} m. [(CO1)(Apply/IOCQ)]
- (c) Determine how many radiation shield with surface emissivity of 0.02 will be required to reduce the radiation heat transfer between two large parallel planes with surface emissivity of 0.85 by a factor of 50. [(CO1)(Evaluate/HOCQ)]
- 2 + 4 + 6 = 12**
3. (a) What is hour angle of a place at 8 A.M solar time? [(CO1)(Understand/LOCQ)]
- (b) Determine the number of sunshine hour at Kolkata (latitude 22.57°) on the day of your exam. [(CO1)(Apply/IOCQ)]
- (c) Determine an expression of extraterrestrial radiation that can be received from sun at any given place on earth at any given date over the entire day. Using the expression predict extraterrestrial solar radiation that has been received over Kolkata, India (22.5° N, 88.3° E) on 15th May, 2022. Given: Solar constant is 1350 W/m². [(CO1)(Evaluate/HOCQ)]
- 2 + 4 + 6 = 12**

Group - C

4. (a) Discuss how the overall heat loss coefficient of a flat plate collector can be determined. What are the basic assumptions needs to be taken for the thermal analysis of flat plate collector? [(CO2)(Understand/LOCQ)]
- (b) Estimate the tilt factor for beam radiation of a south facing collector with an angle of inclination 45° at Kolkata, India (22.6° N, 88.4° E) on 2:00 PM solar time on 21st June. [(CO2)(Apply/IOCQ)]
- 6 + 6 = 12**
5. (a) Discuss with a schematic diagram how solar cell converts solar energy into electrical energy. What are merits and demerits of thin film technology of solar cell production? [(CO2)(Analyze/IOCQ)]
- (b) Define Fill Factor, Open circuit voltage, Short circuit voltage, Maximum output power and conversion efficiency of solar photovoltaic cell. [(CO2)(Understand/LOCQ)]
- 7 + 5 = 12**

Group - D

6. (a) Describe the difference between the role of horizontal axis and vertical axis in a wind turbine. [(CO3)(Understand/IOCQ)]

- (b) Write a short note on the working principle of wind rotors and its performance. [(CO3)(Analyze/IOCQ)]
6 + 6 = 12
7. (a) Write short notes on:
i) Local effect
ii) Wind shear
iii) Acceleration effect. [(CO1)(Remember/IOCQ)]
(b) Describe the different methods for the measurement of wind. [(Understand/LOCQ)]
(3 × 2) + 6 = 12

Group - E

8. (a) Write a short note on wind electric generators. [(Apply/IOCQ)]
(b) Write a short note on the limitation of wind piston pump and the effect of hysteresis. [(CO4)(Evaluate/HOCQ)]
6 + 6 = 12
9. (a) Discuss the environmental problem associated with the wind turbine. [(Apply/IOCQ)]
(b) Explain the economic analysis for wind turbine in India along with the factors involved. [(Understand/HOCQ)]
6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	28.12	46.88	25

Course Outcomes (CO):

After completing this course students will be able to:

1. Understand different technologies used for solar collectors.
2. Students will be able to evaluate the performance and efficiency of different devices that extract power from solar energy.
3. Students will be able to understand the main components of wind energy system and its functions.
4. Understand the different types of wind turbines.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question

