

Unit 12 - Week 10: Solar Concentrating Collectors

Course outline
How does an NPTEL online course work?
Week 0 : Prerequisite
Week 1: Introduction to Solar Energy
Week 2: Solar Radiation Geometry
Week 3: Solar Radiation Estimation
Week 4: Fundamentals of Photovoltaic Conversion
Week 5: Standalone Photovoltaic System
Week 6: Grid connected PV system
Week 7: Fundamentals of Flat Plate Collectors
Week 8: Flat Plate Collectors
Week 9: Solar Air Heaters
Week 10: Solar Concentrating Collectors
<input checked="" type="radio"/> Lec 26: Fundamentals of concentrating collectors <input type="radio"/> Lec 27: Concentrating collector technologies and working principle <input type="radio"/> Lec 28: Tutorial : Concentrating Collector
<input type="radio"/> Quiz : Assignment 10 <input type="radio"/> Feedback Form <input type="radio"/> Lecture Slides <input type="radio"/> Assignment solution
Week 11: Thermal Energy Storage
Week 12: Applications of Solar Energy
Text Transcripts
Live Session

Assignment 10

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2020-11-26, 23:59 IST.

- 1) For a linear (line focused) concentrator with an acceptance angle of 15 degree, the concentration ratio of the system is 1 point
- a. 3.86
 b. 7.66
 c. 15
 d. 215

No, the answer is incorrect.
Score: 0

Accepted Answers:
b. 7.66

- 2) Which of the following collector has maximum concentration ratio? 1 point
- a. Central tower receiver
 b. Paraboloidal concentrator
 c. Cylindrical parabolic concentrator
 d. Fresnel concentrator

No, the answer is incorrect.
Score: 0

Accepted Answers:
a. Central tower receiver

- 3) The collector efficiency of a solar concentrating power plant is 28 % and the mechanical (Carnot) efficiency is 90 %. The overall efficiency (%) of the CSP plant is 1 point
- a. 15
 b. 18
 c. 20
 d. 25

No, the answer is incorrect.
Score: 0

Accepted Answers:
d. 25

- 4) Match the following concentrating collectors with their output temperature range 1 point
- | | |
|-------------------------------|------------------|
| I. Parabolic trough collector | i. 50-300 °C |
| II. Solar power tower | ii. 20-400 °C |
| III. Linear Fresnel Reflector | iii. 120-1500 °C |
| IV. Paraboloid Dish | iv. 300-565 °C |
- a. I-ii, II-iv, III-i, IV-iii
 b. I-i, II-iv, III-ii, IV-iii
 c. I-ii, II-iii, III-i, IV-iv
 d. I-i, II-ii, III-iv, IV-iii

No, the answer is incorrect.
Score: 0

Accepted Answers:
a. I-ii, II-iv, III-i, IV-iii

Common data for Q5 and Q6

For a collector having aperture area of 240 square meter, the concentration ratio is 20. The absorber surface achieves a temperature of 375 degree Celsius and the overall heat loss co-efficient is 5 Watt per square meter per degree Celsius. The ambient air temperature is 25 degree Celsius. Solar beam radiation falling on the absorber is 650 Watt per square meter.

- 5) The rate of heat loss (kilo Watt) from the absorber is 1 point
- a. 10
 b. 21
 c. 45
 d. 420

No, the answer is incorrect.
Score: 0

Accepted Answers:
b. 21

- 6) The rate of useful heat gain (kilo Watt) is 1 point
- a. 7.8
 b. 21
 c. 135
 d. 156

No, the answer is incorrect.
Score: 0

Accepted Answers:
c. 135

Common data for Q7 – Q9

For a cylindrical parabolic concentrator having 12 m length and 3.5 m width, the inside and outside diameter of the absorber tube are 6 cm and 8 cm respectively. The inlet temperature of the fluid to be heated is 150 °C with a flow rate of 500 kg/hr. The incident beam radiation is 800 W/m² and the ambient temperature is 27 °C. The heat transfer coefficient on the inside surface of the tube is 50 W/m² °C. Consider the latitude of the location and slope as 18.52° and 9.6° respectively. The optical properties are given below-

Specular reflectivity of the concentrator surface = 0.85
Average transmissivity-absorptivity product for beam radiation = 0.81
Intercept factor = 0.93
Specific heat = 1.256 kJ/kg °C
Overall heat loss coefficient = 7.5 W/m² °C
The data are obtained for March 15th at 1300 hours (LAT).

- 7) The useful heat gain rate (in kW) is 1 point
- a. 6.78
 b. 10.45
 c. 15.77
 d. 23.27

No, the answer is incorrect.
Score: 0

Accepted Answers:
c. 15.77

- 8) The outlet temperature of the fluid (in degree Celsius) is 1 point
- a. 127
 b. 240
 c. 423
 d. 513

No, the answer is incorrect.
Score: 0

Accepted Answers:
b. 240

- 9) The instantaneous collection efficiency is 1 point
- a. 21.22
 b. 33.12
 c. 40.45
 d. 44.65

No, the answer is incorrect.
Score: 0

Accepted Answers:
d. 44.65

Common data for Q10 - Q12

A central receiver collector system consists of 1800 heliostats, each 6.5 meter × 6.5 meter in size. The height of the central tower is 84 meter and rim angle is 81 degree. Assume that the angular error associated with heliostats does not exceed 0.0055 radians and that the heliostats are suitably dished.

- 10) The size of the image (meter) formed by the outermost arc of the heliostats at the receiver is 1 point
- a. 4.585
 b. 7.921
 c. 20.64
 d. 42.25

No, the answer is incorrect.
Score: 0

Accepted Answers:
b. 7.921

- 11) The size of the receiver (square meter) is 1 point
- a. 15.85
 b. 112.52
 c. 188.21
 d. 394.27

No, the answer is incorrect.
Score: 0

Accepted Answers:
c. 188.21

- 12) The concentration ratio is 1 point
- a. 193
 b. 404
 c. 712
 d. 2400

No, the answer is incorrect.
Score: 0

Accepted Answers:
b. 404