

## Unit 13 - Week 11: Thermal Energy Storage

### 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

Week 11: Thermal Energy Storage

Lec 29: Sensible heat, latent heat and thermochemical energy storage

Lec 30: Solar pond

Lec 31: Tutorial - Solar pond power plant design

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Week 12: Applications of Solar Energy

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## Assignment 11

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

**Due on 2020-12-02, 23:59 IST.**

1) The thermal energy storage system design depends on 1 point

- a. Temperature difference
- b. Capacity of the storage system
- c. Cost of the storage system
- d. All the above

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
d. All the above

2) The storage capacity of solar thermal storage systems depends on 1 point

- a. Available solar radiation
- b. Physical and chemical properties of the storage medium
- c. Nature of thermal process
- d. All the above

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
d. All the above

3) Limitation of using sensible heat storage are 1 point

- (i) Can't deliver energy at constant temperature
- (ii) Bigger in size
- (iii) Simple in design

- a. Only (i) is correct
- b. Only (ii) is correct
- c. (i) and (ii) are correct
- d. (i), (ii) and (iii) are correct

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
c. (i) and (ii) are correct

4) Desirable properties of phase change material are 1 point

- (i) High latent heat of fusion
- (ii) Small volume change during melting
- (iii) Minimum super cooling or super heating
- (iv) High thermal conductivity

- a. (i) and (ii) are correct
- b. (i), (ii), (iii) and (iv) are correct
- c. (i) and (iii) are correct
- d. (ii) and (iii) are correct

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
b. (i), (ii), (iii) and (iv) are correct

5) Thermochemical storage systems are suitable for 1 point

- (i) Low temperature applications (*below*100°C)
- (ii) Medium temperature applications (110 – 400°C)
- (iii) High temperature applications (*above*400°C)

- a. Only (i) is correct
- b. Only (ii) is correct
- c. (ii) and (iii) are correct
- d. (i) and (ii) are correct

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
c. (ii) and (iii) are correct

6) The percentage of energy absorbed in the surface convective zone of a solar pond is 1 point

- a. 10
- b. 20
- c. 30
- d. 50

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
c. 30

7) In case of a non-convective solar pond, the maximum temperature is obtainable at 1 point

- a. The middle position
- b. The bottom surface
- c. The top surface
- d. None of these

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
b. The bottom surface

8) Which of these following methods are used to accomplish the non-convective mode of the solar pond? 1 point

- a. Salt-stabilized
- b. Partitioned or membrane
- c. Viscosity stabilized
- d. All the above

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
d. All the above

9) An insulated tank is filled with 1000 liter olive oil with density and specific heat of 920 kg per cu. meter and 1970 J per kg per Kelvin respectively for a temperature drop of 100°C from the boiling point (570 Kelvin). The thermal energy lost (in Joule) from the tank is 1 point

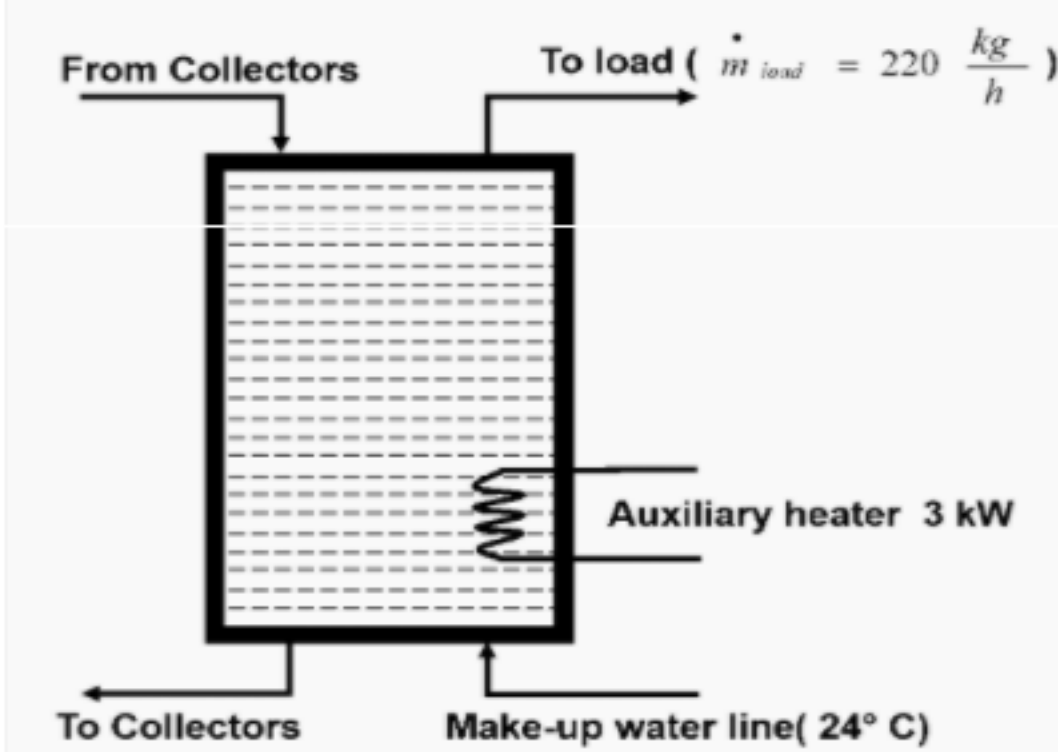
- a.  $5.2 \times 10^{11}$
- b.  $6.76 \times 10^{11}$
- c.  $7.53 \times 10^{11}$
- d.  $8.89 \times 10^{11}$

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
b.  $6.76 \times 10^{11}$

### Common data for Q10 and Q11

A well-mixed water storage unit contains 3000 kg of water and is provided with an auxiliary heating of 3 kW shown in the figure below. The ambient temperature and the rate of mass withdrawal to the load are 18°C and 220 kg per hour respectively. Assume that there is no heat gain to the water and the auxiliary heater switches on when the temperature of the water in the tank fall below 45°C. The make-up water enters the tank at 24°C and at the same rate as the rate of withdrawal to the load. The overall heat-transfer coefficient between the liquid in the tank and the ambient air is 6 kW per sq. meter per °C. The surface area of the tank is 10 sq. meter. Consider the specific heat of water to be 4.2 kJ per kg per Kelvin.



10) If the present temperature of the tank is 46°C at 0500 hours, the temperature after 1 hour is 1 point

- a. 41.2
- b. 44.3
- c. 39.2
- d. 35.2

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
b. 44.3

11) The auxiliary heater is switched on at 1 point

- a. 0732 hours
- b. 0610 hours
- c. 0532 hours
- d. 0650 hours

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
c. 0532 hours

12) A solar pond is maintained with a negative density gradient of -0.5 kg per cu. meter per °C while the salt-density gradient due to concentration is 650 kg per cu. meter. If the concentration at the top of is 0.02 and a temperature difference of 65°C it to be maintained, the minimum concentration (kg of salt per kg of water) required at the bottom is 1 point

- a. 0.07
- b. 1.56
- c. 3.23
- d. 2.89

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
a. 0.07