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B.Tech DEGREE EXAMINATION, DECEMBER 2023

Seventh Semester

18MEE445T - THERMAL ENERGY STORAGE SYSTEMS

(For the candidates admitted during the academic year 2020 - 2021 & 2021 - 2022)

Note:

i. **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.

ii. **Part - B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours **Max. Marks: 100**

PART - A (20 × 1 = 20 Marks)

Answer **all** Questions

		Marks	BL	CO
1.	Select the operating temperature range for solar domestic hot water supply system. (A) Below 10 °C (B) 20 °C - 100 °C (C) 100 °C - 250 °C (D) Above 250 °C	1	2	1
2.	Which of the following is a type of TES system? (A) Flywheel (B) Borehole (C) Compressed air energy storage (D) Electrical battery	1	2	1
3.	_____ is employed as the heat carrier fluid in aquifer. (A) Distilled water (B) Rainwater (C) Sea water (D) Ground water	1	2	1
4.	Long term seasonal TES systems store heat at _____ temperatures below 80° C and require _____capacity. (A) low, very small (B) high, very small (C) low, very large (D) high, very large	1	2	1
5.	ΔT during charging and discharging is less in _____ when used in thermal storage system. (A) Clay (B) Rock (C) Concrete (D) Water	1	3	2
6.	Which of the following is a single medium Stratified TES tank configuration? (A) Liquid storage medium in thermocline tank (B) Phase change medium with tubular heat exchanger (C) Solid storage medium with tubular heat exchanger (D) Solid PCM storage with direct contact heat exchange	1	2	2
7.	The drawback of using water as sensible heat storage (A) low specific heat (B) low thermal conductivity (C) high density (D) limited temperature range	1	2	2
8.	A solar pond is a combination of _____ (A) chemical energy storage and collection (B) solar energy collection and thermal energy storage (C) solar energy collection and mechanical energy storage (D) solar energy collection and electrical energy storage	1	2	2
9.	Eutectic PCM has higher _____ than the water. (A) lower melting point (B) higher boiling point (C) higher melting point (D) lower boiling point	1	2	3
10.	Choose kinetic property for latent thermal energy storage systems. (A) Non-toxic (B) Latent heat of fusion (C) High specific heat (D) Nucleation	1	2	3

11.	Thermal conductivity of ice is _____ (A) 2.2 W/mK (B) 0.6 W/mK (C) 6.4 W/mK (D) 4.2 W/mK	1	2	3
12.	Disadvantage of most PCM materials is _____ leading to _____. (A) low thermal conductivity, high heat transfer rate (B) low thermal conductivity, low heat transfer rate (C) high thermal conductivity, low heat transfer rate (D) high thermal conductivity, high heat transfer rate	1	2	3
13.	Select the material which is having high specific heat at constant pressure surrounding conditions (A) rock (B) ceramic (C) glass (D) water	1	2	4
14.	Thermal conductivity enhancement can be achieved through dispersing _____ in PCM. (A) NaCl (B) octadecane (C) Psedomonousflurosence (D) TiO	1	2	4
15.	Differential Scanning Calorimeter (DSC) is used for measuring (A) phase change property (B) thermal conductivity (C) viscosity (D) density	1	2	4
16.	Thermal conductivity enhancement of PCM results in _____ (A) decrease in heat transfer rate (B) no change in heat transfer rate (C) increase in latent heat (D) increase in heat transfer rate	1	2	4
17.	Which one of the following is not a thermophysical property? (A) Thermal diffusivity (B) Specific heat (C) Heat of fusion (D) Weight density	1	2	5
18.	The specific power consumption of air-conditioning system is increased by _____. (A) rise in evaporator temperatures (B) lowering the evaporator temperature (C) increasing condenser temperatures (D) maintain constant temperature	1	2	5
19.	Which of the following is not a desired characteristics of a HTF? (A) High boiling point (B) Low viscosity (C) High thermal conductivity (D) High vapour pressure at high temperature	1	2	5
20.	PCM heat exchanger in an AC unit _____. (A) decreases the inlet air temperature of the condenser (B) increases the inlet air temperature of the condenser (C) decreases the inlet air temperature of the evaporator (D) increases the inlet air temperature of the evaporator	1	2	5

PART - B (5 × 4 = 20 Marks)

Answer **any 5** Questions

		Marks	BL	CO
21.	List out the different types of energy storage systems.	4	2	1
22.	Describe the need of thermal energy storage systems.	4	2	1
23.	Explain underground sensible thermal energy storage system with neat sketch.	4	1	2
24.	Why thermal stratification is necessary in storage tank?	4	2	2
25.	Distinguish the latent heat and sensible heat storage system.	4	2	3
26.	Why supercooling is not desirable during phase change energy storage?	4	2	4

		Marks	BL	CO
27.	What is the effect of PCM in the solar dryer?	4	2	5

PART - C (5 × 12 = 60 Marks)

Answer **all** Questions

		Marks	BL	CO
28.	(a) Describe high temperature solar thermal energy storage system with neat sketch.	12	2	1
	(OR)			
	(b) Explain the seasonal thermal energy storage system in detail with neat sketch. i) Aquifer storage ii) Rock bed thermal storage system			
29.	(a) Describe about the solar pond thermal storage with neat sketch in detail.	12	2	2
	(OR)			
	(b) Explain high temperature sensible thermal energy storage system with neat sketch.			
30.	(a) Classify PCM and discuss the desirable thermal, physical, kinetic and economic properties of PCM?	12	2	3
	(OR)			
	(b) Explain the working of thermochemical energy storage systems with neat sketch?			
31.	(a) Explain the need for heat transfer enhancement in a thermal storage system and various methods to achieve it.	12	2	4
	(OR)			
	(b) Calculate the energy storage capacity of the unit an organic PCM of n-Hexadecane with melting point of 18°C and specific gravity of 0.8 is used for building air-conditioning. The PCM unit has a volume of 2 m^3 and latent heat of fusion of n-Hexadecane is 225 kJ/kg. it outside air at 32°C has to be cooled down (PCM to be frozen) to 22°C by the PCM and supplies indoor from 10am to 4pm. What should be the maximum mass flow rate of air? Neglect sensible heating of PCM and assume specific heat of air 1.0 kJ/kg K.			
32.	(a) Describe the construction and working function of cool thermal energy storage with neat sketch?	12	2	5
	(OR)			
	(b) Explain the design and working principle of thermal energy storage systems used with solar dryers.			

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