



UNIVERSITY EXAMINATIONS
THIRD YEAR EXAMINATION FOR THE AWARD OF
THE DEGREE OF BACHELOR OF SCIENCE IN RENEWABLE ENERGY

SECOND SEMESTER 2021/2022
(FEBRUARY – JUNE, 2022)

PHRE 321: SOLAR ENERGY THERMAL CONVERSION II

STREAM: Y3 S2

TIME: 2 HOURS

DAY: MONDAY, 12:00 PM – 2:00 PM

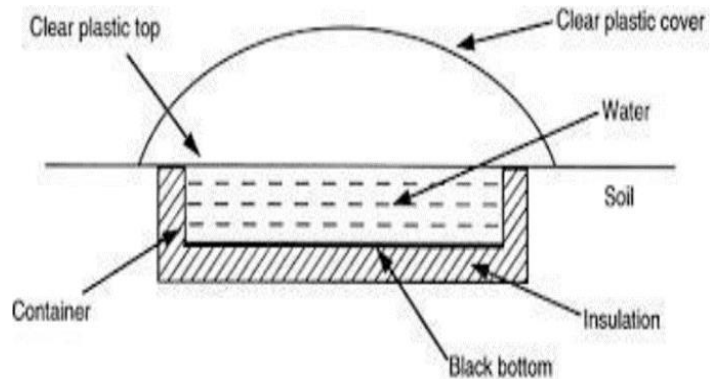
DATE: 23/05/2022

INSTRUCTIONS

- 1. Do not write anything on this question paper.***
- 2. Answer Question ONE (Compulsory) and any other TWO questions.***
- 3. Question one carries 30 marks while the other carry 20 marks.***

QUESTION ONE

- Define solar thermal and state its mode of transfer. [1mark]
- State any two advantages of flat plate collector. [2marks]
- Name any two advantages and disadvantages of solar energy. [2marks]
- With the help of a diagram, discuss the cabinet type of solar dryer [4Marks]
- State three applications of solar bonds. [3Marks]
- State and explain any four factors that affects the performance of a flat plate collector. [4marks]
- State four major applications of solar energy [2marks]
- Identify the device and explain its operation. [4marks]



- i. State two disadvantages of solar drying systems [3marks]
- j. Define the following performance indices. [3Marks]
 - i. Collector efficiency
 - ii. Concentration ratio
 - iii. Temperature range
- k. Discuss any two merits of solar cookers [2marks]

QUESTION TWO

- a. Discuss the five Essential subsystems in a solar thermal energy power plant. [5marks]
- b. A parabolic trough was designed and data collected based on its working conditions were recorded in the table below;

Table

No.	Time	Flow rate		Solar intensity	
		m ³ /s	Kg/hr	Mv	kJ/hr-m ²
1	11:00	5.83×10^{-6}	21	7.4	3442.77
2	12:00	5.83×10^{-6}	21	7.5	3387.94

Using the information in the table, determine

- i. The total heat available in the concentrator for the two distinct hours. [6marks]
- ii. The total heat gained by the water for the two distinct hours [4marks]
- iii. The efficiency of the parabolic trough for the two distinct hours. Comment on the efficiency. [4marks]
- c. State one demerit of a solar cooker [1mark]

QUESTION THREE

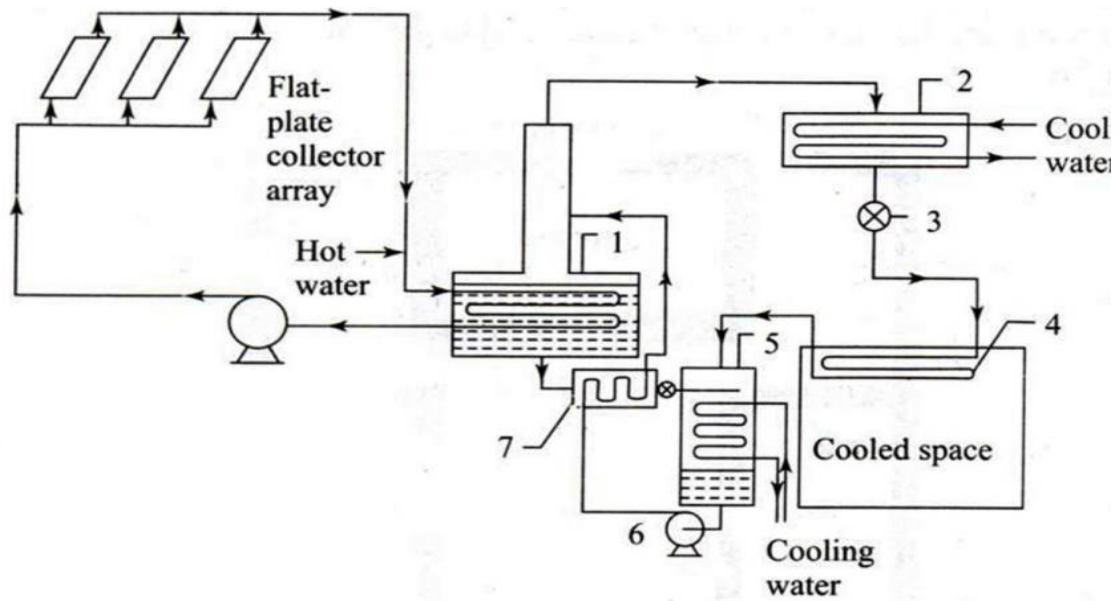
- a. "Space heating is of particular relevance in colder countries where a significant amount of energy is required for the heating". In reference to this statement, discuss in details the two methods through which space heating is done. (Use a diagram where necessary) [8 Marks]
- b. A solar water heater system is comprised of three major components, stating the components; discuss in brief how it works. [5marks]
- c. Discuss the working of a solar kettle. [3marks]
- d. Discuss concentrator type of cooker for community cooking. [4marks]

QUESTION FOUR

- a. Explain the principle working of the solar pond as a device for collecting and storing solar energy. [4Marks]
- b. With the aid of diagrams, give a brief description of the following solar collectors; [16marks]
 - i. Linear Fresnel Reflector. (LFR)
 - ii. Evacuated tube collector. (ETC)
 - iii. Central tower receiver collector. (CTR)
 - iv. Hemispherical Bowl Mirror Concentrator

QUESTION FIVE

- a. Discuss the constructional details of a flat plate collector. [4marks]
- b. State two demerits of solar cooker. [2marks]
- c. The figure below shows a simple solar space cooling and refrigeration system. Study it and use it to answer the questions that follows;



- i. Name the parts 3,5 and 6 and state their functions. [3marks]
- ii. Explain how refrigerator works to keep a food product at low temperature hence increase its shelf life [5marks]
 Calculate outlet temperature of water, stagnation temperature and useful heat output. [6marks]