UNIVERSITY COLLEGE TATI

UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET		
COURSE CODE	:	DEE 2242
COURSE	:	FUNDAMENTAL OF RENEWABLE ENERGY
SEMESTER / SESSION	:	01 - 2024/2025
DURATION	:	2 HOURS

Instructions:

1. This booklet contains **4** question sets. Answer **ALL**.
2. All answers should be written in the answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise your hand and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 6 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

a) Name any **one (1)** region of the solar radiation spectrum. (1 mark)

b) Explain the Wind Power Density (WPD). (5 marks)

c) Explain the relationship between the classes in the NREL class index and the WPD calculations. (2 marks)

d) State the full name for the following types of wind turbine.

i) VAWT (1 mark)

ii) HAWT (1 mark)

e) Explain the net results of a basic fuel cell chemical reaction. (3 marks)

QUESTION 2

a) Describe the operation of concentrated solar power (CSP) system in electrical energy generation. (5 marks)

b) State the **two (2)** factors that power extraction from water depends upon in conventional dam hydroelectricity. (2 marks)

c) Explain the storage principle of the pump-storage hydroelectricity operation. (4 marks)

d) Calculate the hydropower available if a hydroelectric dam has a 20 m head with 50 m^3/s volume flow rate if the turbine used is 70% efficient. (3 marks)

QUESTION 3

a) Explain the photovoltaic effect occurring in solar cells. (6 marks)

b) Describe the ocean wave power. (3 marks)

c) Explain the growth contributors of ocean waves. (3 marks)

d) Write the location names of **(i)** to **(iii)** for placing ocean wave energy converters based on the location distance from the seashore in Table 1.

Table 1

Location Name	Distance from Shore	
(i)	Water meets shore	(1 mark)
(ii)	To depth of 20 m	(1 mark)
(iii)	From depth of 20 m outward	(1 mark)

e) State the **four (4)** important design features of a basic fuel cell. (4 marks)

QUESTION 4

a) Name **two (2)** crystalline formations of first generation semiconductor-based solar cells. (2 marks)

b) State any **one (1)** of the second generation thin film solar cells. (1 marks)

c) Describe the Earth's internal heat. (5 marks)

d) Explain the operation of a binary cycle geothermal power station with the help of Figure 2 (4 marks)

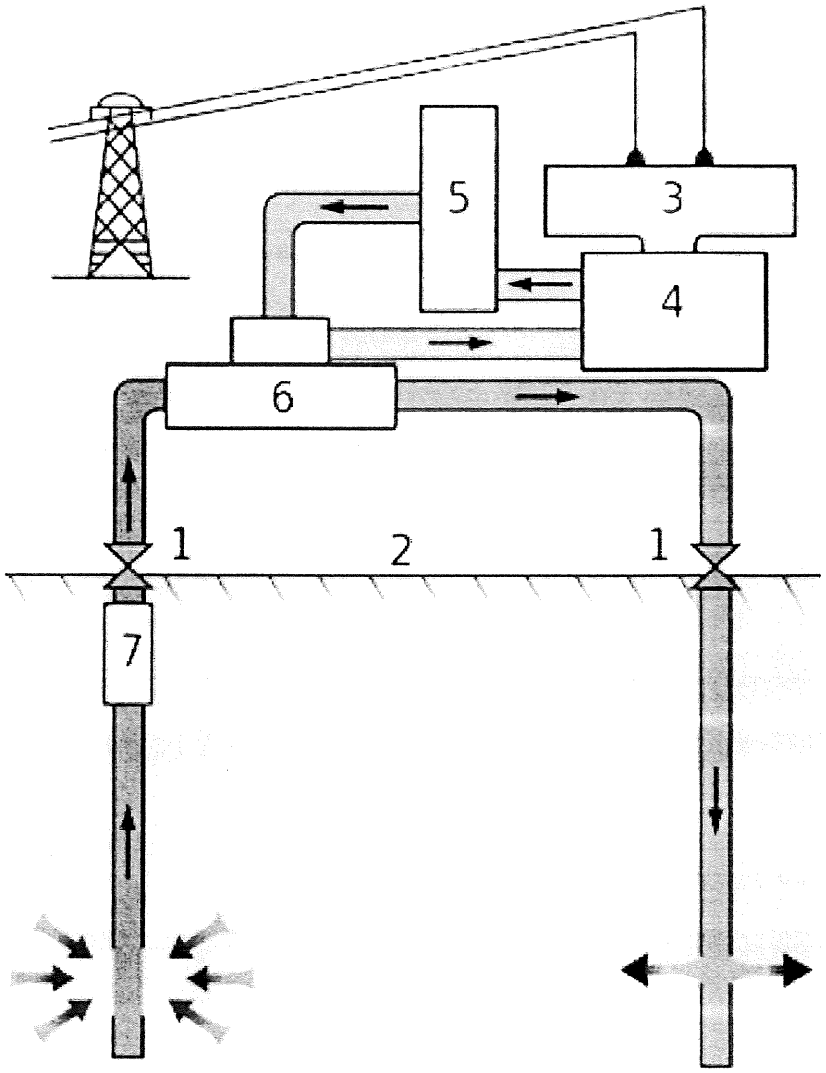

Figure 2

e) State any **two (2)** fuel cell technologies. (2 marks)

----------End of Questions----------

FORMULA SHEET

Hydroelectricity

Hydropower output

$$P = \eta \rho g Q H$$

where:

P	: mechanical power produced at the turbine shaft (Watts)
η ('eta')	: hydraulic efficiency of the turbine
ρ ('rho')	: density of water (1000 kg/m^3)
g	: acceleration due to gravity (9.81 m/s^2)
Q	: volume flow rate passing through the turbine (m^3/s)
H	: effective pressure head of water across the turbine (m)

Capacity factor (CF)

$$CF\ (\%) = \frac{\text{energy generated per year (kWh/year)}}{\text{installed capacity (kW) x 8760 hours/year}}$$

Annual Energy Output

$$\text{Energy (kWh/year)} = P\ (kW) \times CF \times 8760$$