

**UNIVERSITY COLLEGE TATI (UC TATI)****FINAL EXAMINATION QUESTION BOOKLET**

COURSE CODE	:	DEE 2242
COURSE	:	FUNDAMENTAL OF RENEWABLE ENERGY
SEMESTER / SESSION	:	02 - 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 4 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

- a) State the definition for wind power. (3 marks)
- b) State the full name for the following types of wind turbine.
- i) VAWT (1 mark)
 - ii) HAWT (1 mark)
- c) Explain the Wind Power Density (WPD) calculation. (5 marks)
- d) Describe the relationship between the classes in the NREL class index and their WPD calculation values. (2 marks)
- e) Provide the definition of fuel cell. (3 marks)

QUESTION 2

- a) List the **three (3)** downside of damming. (3 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 operation of the pump-storage hydroelectric station. (4 marks)
- d) Calculate the hydropower available if a hydroelectric dam has a 20 m head with 50 m³/s volume flow rate if the turbine used is 70% efficient. (3 marks)
- e) Explain the net results of a basic fuel cell chemical reaction. (3 marks)

QUESTION 3

- a) Describe the ocean wave power. (3 marks)
- b) Explain the growth contributors of ocean waves. (3 marks)
- c) 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)

- d) List any **three (3)** types of energy wave converters. (3 marks)
- e) State any **three (3)** important design features of a basic fuel cell. (3 marks)

QUESTION 4

- a) Describe geothermal gradient. (3 marks)
- b) Describe the Earth's internal heat. (5 marks)
- c) Describe the operation of the dry steam geothermal power station. (4 marks)
- d) State any **three (3)** fuel cell technologies. (3 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)

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

Annual Energy Output

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