



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCES

DEPARTMENT OF APPLIED PHYSICS

RENEWABLE ENERGY TECHNOLOGY

SPH 4125

First Semester Examination Paper

December 2024

This examination paper consists of 3 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: None

Examiner's Name: Ms E MUGABE

INSTRUCTIONS

ANSWER ALL PARTS OF QUESTION 1 IN SECTION A AND ANY THREE QUESTIONS FROM SECTION B. SECTION A CARRIES 40 MARKS AND SECTION B CARRIES 60 MARKS.

MARK ALLOCATION

QUESTION	MARKS
1.	40
2.	20
3.	20
4.	20
5.	20
6.	20
Maximum possible mark	100

SECTION A

1. (a) Explain what is meant by a “renewable energy” resource, giving examples of renewable energy resources. [3]
- (b) (i) Define global warming. [2]
- (ii) How can global warming be controlled? [5]
- (c) Define the following terms
 - (i) Solar constant [2]
 - (ii) Solar irradiance [2]
 - (iii) Declination angle [2]
- (d) List information which is contained in solar radiation data. [6]
- (e) Write brief notes on the differences between pyrheliometers and pyranometers. [4]
- (f) State the five types of geothermal energy resources. [5]
- (g) Discuss the environmental issues associated with hydropower plant development. [5]
- (h) Describe the relationship between energy and sustainable development. [4]

SECTION B

2. (a) What do you understand by the term “photovoltaic conversion” [2]
 - (b) Describe the effect of cell temperature on PV cell efficiency. [5]
 - (c) Identify the major elements of a basic photovoltaic system and with the aid of a well labelled diagram explain how a basic photovoltaic system is integrated with the utility grid. [8]
 - (d) Explain in detail the factors which affect solar collector system efficiency. [5]
3. (a) Define the following terms;
 - (i) Tip speed ratio [2]
 - (ii) Capacity factor [2]
 - (b) State the important uses of wind energy. [2]

- (c) With the aid of clear sketch diagrams, explain in detail the working principle of vertical axis wind turbines (VAWT) and horizontal axis wind turbines (HAWT). [10]
- (d) What are the effects of lift and drag. Explain the importance of these factors in wind power generation. [4]
4. (a) Define concentration ratio [2]
- (b) State any four applications of solar air heaters. [4]
- (c) A flat plate collector is an example of a non-concentrating collector, with the aid of a clear and well labelled diagram explain its construction and working principle. What are its advantages? [8]
- (d) Determine the angle made by beam radiation with the normal to a flat plate collector, pointing the south location in Bulawayo ($13^{\circ} N, 80.27^{\circ} E$) at 11:00 hr solar time on the 17th of April. The collector is tilted at an angle of 32° with the horizontal. [6]
5. (a) List the constituents of biogas. [2]
- (b) Define the following terms
- (i) Liquefaction [2]
- (ii) Gasification. [2]
- (c) Describe in detail any seven factors which affect biogas generation. [14]
6. (a) Differentiate flat plate collectors and concentrating collectors. [4]
- (b) State and explain the factors which affect solar collector system efficiency. [6]
- (c) Describe the major factors which influence the electrical design of solar arrays. [8]
- (d) State any two applications of solar PV systems. [2]

*******END OF EXAMINATION PAPER*******