University of Ruhuna- Faculty of Technology
Bachelor of Engineering Technology Honours Degree
Level 2 (Semester I) Examination, July 2023
Academic year 2021/2022

Course Unit: ENT2132-Renewable and Alternative Energy Technology   **Duration: 2 hours**

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- All symbols have their usual meanings.
- Answer all **Four (04)** questions.
- Calculators are allowed for this examination.

1) Biomass is an important renewable energy resource that can be used to generate electricity and heat.

   a) Define what biomass is and give **three** sources of it.

   (5 marks)

   b) What is anaerobic digestion, and how does it work as a process for converting organic waste into energy and fertilizer?

   (7 marks)

   c) Consider the following **four** biomass energy sources:

   > Corn ethanol with an EROI of 1.3:1
   > Switch grass with an EROI of 5:1
   > Wood pellets with an EROI of 10:1
   > Municipal solid waste with an EROI of 3:1

   Define the concept of energy return on investment (EROI) and explain the implications of EROI on their potential use as sustainable energy sources.

   (6 marks)

   d) Imagine you are tasked with establishing a biofuel production plant in your faculty. What are the potential biomass sources for producing biofuels? Justify your answer in terms of sustainability, cost-effectiveness and feasibility.

   (7 marks)

2) Sri Lanka is facing an energy crisis due to its heavy reliance on imported fossil fuels.
   a) State **two** disadvantages for each of the following applications of different fossil fuels.
      I.   Cooking with imported fossil gas
      II. Transportation with imported petroleum
      III. Energy production with imported coal

   (9 marks)

   b) Explain possible alternatives to solve the energy crisis in Sri Lanka including solutions for cooking, transport, and energy production.
   Note: Your answer should contain at least **six** solutions (i.e. minimum **two** for each category).

   (16 marks)

3) Wind turbines are a popular mode of renewable energy conversion due to their ability to convert the kinetic energy of the wind into electrical power.

a) List **four** factors that can affect the power output of wind turbines. How can these factors be optimized to improve the efficiency of a turbine?

(8 marks)

b) Write down the Betz's Law equation for wind turbines.

(3 marks)

c) Using the above-mentioned equation, determine the efficiency of a wind turbine having 6 m long blades if it produces 65 kW of electricity at a wind speed of 15 m/s. Assume that the density of air is 1.2 kg/m^3.

(6 marks)

d) Wind data collected for a period of 24 hrs at a given location indicates that the average wind velocity is 10 m/s for the first 12 hours and 5 m/s for the second 12 hours, respectively. If it is planned to install a wind turbine having 10 m long blades which can operate at an overall efficiency of 30%, answer the following questions.

i. Calculate the total amount of energy produced for 24 hrs.

(2 marks)

ii. Repeat the calculation, if the average wind velocity is 7.5 m/s.

(2 marks)

iii. Compare the answers of i) and ii) and explain reasons for any difference.

(4 marks)

4)

a) Provide a clear explanation for tidal energy, highlighting its significance as a renewable source.

(3 marks)

b) Discuss **two** key methods of harnessing tidal energy, along with advantages and disadvantages of each method.

(8 marks)

c) Calculate the full wave power of an oceanic wave of height of 2.5 m and having a crest length of 0.2 m in 15 ms. You may take the gravitational constant (g) as 9.8 m/s^2 and the density of sea water (ρ) as 1025 kg/m^3.

(5 marks)

d) Briefly explain the following terms with the aid of clearly drawn sketches.

    i   Solar pond
    ii   Salinity gradient
    iii Thermal gradient

                                                      (9 marks)

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