



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 7 Examination in Engineering: May 2023

Module Number: ME 7211

Module Name: Energy Technology

[Three Hours]

[Answer all questions, each question carries 10 marks]

- Q1. a) Draw a schematic diagram of the arrangement of a small hydropower plant and name its key components. Write short notes on any of the **two (02)** key components, focusing on the purpose and design considerations. [4.0 Marks]
- b) Name **three (03)** turbine types frequently used in small hydropower plants and compare their advantages and disadvantages in terms of installation and performance characteristics. [3.0 Marks]
- c) Draw a schematic diagram of any type of wave energy converter of your interest and explain its operation principles as it interacts with incoming waves. Also, briefly explain its advantages and disadvantages in terms of performance and durability. [3.0 Marks]
- Q2. a) Discuss renewable and conventional forms of energy available in the world. Highlight their merits and demerits. [3.0 Marks]
- b) By using neatly drawn sketches, explain the Green House Effect on the earth. [3.0 Marks]
- c) Name **four (04)** Green House Gases (GHG) emitted to the atmosphere and state the main human activity source responsible for the generation of each of the GHG. [4.0 Marks]
- Q3. a) State the definition of biogas. What would be the normal composition of biogas? [3.0 Marks]
- b) What are the triple important benefits you can obtain from Biogas Technology? [3.0 Marks]
- c) By drawing a schematic diagram, briefly explain three stages of anaerobic fermentation of biomass. [1.5 Marks]
- d) Name **five (05)** factors that influence biogas production. [2.5 Marks]

Q4. a) Explain why Sri Lanka needs to utilize solar power for various energy needs compared to other conventional power sources.

[2.0 Marks]

b) PV modules are connected in series or parallel depending on the voltage and power requirements.

(i) Sketch typical I-V and P-V curves of Solar PV panel in one graph and indicate short circuit current, open circuit voltage, and maximum power point.

(ii) Using suitable I-V and P-V curves, explain the maximum power point of a parallel panel setup and series panel setup compared to a single PV panel.

[4.0 Marks]

c) There are **three (03)** main types of solar PV systems: Grid-tied, Hybrid, and Off-grid. Each type of solar panel system has its advantages and disadvantages and it really comes down to what the customer wants to gain from their solar panel installation.

(i) Briefly describe above mentioned three systems using suitable circuit diagrams. Name each component of the diagram.

(ii) What type of system do you recommend for your faculty? Explain with reasons and a suitable circuit diagram.

[4.0 Marks]

Q5. a) A wind turbine extracts energy from the moving air by slowing the air down and transferring the harvested energy into a spinning shaft, which then turns a generator. Many factors will reduce the efficiency of a turbine that needs to be taken into consideration.

(i) List **three (03)** variables that determine the power harvest by a wind turbine.

(ii) Briefly describe three main factors that affected to the wind turbine efficiency.

(iii) If the available wind power is P that can be harvested by a wind turbine and undisturbed wind power is P_0 , obtain an expression for $\frac{P}{P_0}$.

[4.0 Marks]

b) Compare and contrast offshore wind power generation with onshore wind power generation.

[2.0 Marks]

c) Assume that you are asked to design a 10 kW Hybrid (Solar and Wind Power) System for a small canned fish manufacturing plant located on an island.

(i) Propose the required main components for the above system.

(ii) Prepare a list of specifications (**4 specifications**) for each component.

(iii) How do you ensure that the plant will have a constant power supply? Propose any solutions.

[4.0 Marks]