University of Ruhuna- Faculty of Technology

Bachelor of Engineering Technology Honours Degree
Level 2 (Semester I) Examination, June/July 2026
Academic year 2024/2025

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

INSTRUCTIONS TO CANDIDATES:

This paper consists of **10 questions in Section A** and **2 questions in Section B**, spread across **4 pages**.

Answer ALL questions.

Section A carries **50% of the total marks**, with each question worth **5 marks**.

Section B carries the remaining **50%**, with each question worth **25 marks**.

This is a **closed-book examination**.

Calculators are allowed for this examination.

You may assume reasonable values for any data not provided. Clearly state all such assumptions on your answer script.

If you have any doubt as to the interpretation of the wording of a question, make your own decision, but clearly state it on the script.

SECTION - A

Q.1 **Compare** renewable and non-renewable energy sources and give **two relevant examples** for each type.

Q.2 **Describe** the current energy demand situation in Sri Lanka and **identify** major energy sources used in the country

Q.3 Discuss the **environmental and health effects** associated with fossil fuel-based power generation and **explain** how renewable energy can minimize these impacts.

Q.4 Define biomass energy and list **three** common sources of biomass.

Q.5 Explain why biomass is considered a carbon-neutral energy source despite emitting CO_2 during combustion.

Q.6 Describe pumped storage hydropower systems and **explain** their importance in grid stability.

Q.7 Explain the roles of **penstock** and **surge tank** in a hydropower plant.

Q.8 Describe the **net metering system** and **explain** its importance in solar power generation.

Q.9 Define the **air mass ratio** in solar energy and **explain** how it affects solar radiation reaching the Earth's surface.

Q.10 What is a **solar pond** and **how** does it collect and store thermal energy?

SECTION – B

Question 11

Wind turbines are widely used to harness renewable energy by converting the kinetic energy of wind into electrical energy.

a. Sketch a labeled diagram of a Horizontal Axis Wind Turbine (HAWT), showing the following key components:

   i. Blades
   ii. Nacelle
   iii. Gearbox
   iv. Generator
   v. Controller
   vi. Tower

(5 marks)

b. Describe the **roles of the yaw mechanism, gearbox, and controller** in the operation of a horizontal axis wind turbine.

(5 marks)

c. State and explain the Betz limit. Why is the actual efficiency of a wind turbine lower than this theoretical limit?

(5 marks)

d. **d.** A wind turbine has a blade radius of 30 m and operates at a wind speed of 10 m/s. The air density is 1.225 kg/m³ and the power coefficient is 0.38.

   Calculate:

   i. The total available wind power

   ii. The actual electrical power output

(10 marks)

Question 12

Hydropower and tidal energy systems convert natural energy sources into electrical energy using different engineering approaches.

a. Explain the operation of a **run-of-river hydropower plant** and how it differs from a reservoir-based system.

(5 marks)

b. **Classify** hydropower plants based on available water head and describe their main characteristics.

(5 marks)

c. Explain the working principle of a **tidal energy system** (tidal barrage or tidal stream) and mention one advantage and one limitation.

(5 marks)

d. A tidal basin has a surface area of 1.5×10^6 m^2 and a tidal range of 4 m. Calculate the theoretical energy stored in the basin per tidal cycle. (Density of seawater = 1025 kg/m^3, g=9.81 m/s^2)

(10 marks)