# RAJARATA UNIVERSITY OF SRI LANKA
# FACULTY OF APPLIED SCIENCES

Bachelor of Science in Applied Sciences
Third Year - Semester I Examination – July / August 2023

## PHY 3207 – ENERGY RESOURCES

**Time: Two (02) hours**

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This question paper divided into two parts A and B.

**Part A is compulsory.** Part B contains four questions and **answer any three** of them.

Use of a non-programmable calculator is permitted.

Some fundamental constants and physical data;
Water density: 1000 kgm$^{-3}$
Acceleration due to gravity: 9.80 ms$^{-2}$

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## PART A

1. In your opinion, what is the best energy resource for Sri Lanka? Justify your answer according to the sustainability, site selection, accessibility, type of power plant and mechanism. Also state three advantages and three limitations of your selection.

(15 marks)

## PART B

2. Wind power is defined as the use of air flow through wind turbines to provide the mechanical force to generate electricity.

   a) Briefly explain how uneven heating of the Earth surface by the Sun cause the global wind circulations? (03 marks)

   b) Site selection is one of the crucial factors of constructing wind power plant. Give five major requirements that we need to consider when we select a site for wind power plant. (05 marks)

   c) What are the two major types of wind turbines that used in wind mills? State two advantages of each system. (04 marks)

d) The data for a wind turbine is given below:

Wind speed: 14 ms$^{-1}$
Length of blade: 20 m
Air density: 1.23 kgm$^{-3}$.

Hence, calculate the power output of wind turbine in Mega Watts. (03 marks)

3. According to the extent of water flow regulation, hydroelectric power plant can be classified into three categories.

a) i. State the three types of power plant according to the above classification. (03 marks)

ii. Describe one of this power plant type according to the water storage, usage time, generating capacity, reliability and cost. (03 marks)

iii. Explain an advantage and disadvantage for each of three types. (02 marks)

b) What are the functions of following components used in hydroelectric power plant.

i. Surge tank

ii. Penstock

iii. Transformer (03 marks)

c) The Victoria dam lies across the Mahaweli river and holds back a huge reservoir of water producing a head of water for power production of 190 m. All of the river flow passes through the turbines. In a typical year, 780 GWh (Gigawatt-hour) of electricity is produced. Assuming an overall efficiency of 85% for the turbine/ generator, calculate the corresponding average mass flow rate of water. (04 marks)

4. a) Describe two advantages of solar cells over other types of energy conversion devices. (04 marks)

b) Sketch the current density versus voltage (cell potential) curve for a solar cell. Hence, briefly explain the terms, short circuit current density ($J_{sc}$), open circuit voltage ($V_{oc}$), Fill factor and the power conversion efficiency ($\eta$). (05 marks)

c) A silicon solar cell can produce 1.5 V (voltage) and 4.5 W (power) at maximum power point at intensity 1000 Wm$^{-2}$.

i. Calculate the current at maximum power point.

ii. If the short circuit current and the open circuit voltage of the solar cell are 3.6 A and 2.5 V, respectively, calculate the fill factor.

iii. If the active cell area of the solar cell is 100 cm$^2$, calculate the efficiency.

(06 marks)

5. a) Compare the primary batteries with the secondary batteries by considering advantages and disadvantages. (05 marks)

b) Name four main types of primary batteries and briefly explain the working mechanism of two of them. (07 marks)

c) Why do batteries go dead, but fuel cells do not? Justify your answer. (03 marks)

**End.**