



MACHAKOS UNIVERSITY

University Examinations for 2022/2023 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

SECOND / THIRD YEAR FIRST SEMESTER EXAMINATION FOR
BACHELOR OF SCIENCE (APPLIED PHYSICS AND TECHNOLOGY)

SPT205/SPH357: RENEWABLE ENERGY TECHNOLOGY

DATE:

TIME:

INSTRUCTIONS TO CANDIDATES

Answer **QUESTION ONE** and **ANY OTHER TWO** questions.

Question 1 carries **30** marks and the others carry **20** marks each

You may need to use;

$\epsilon_0 = 8.85 \times 10^{-12} \text{F/m}$, $h = 6.626 \times 10^{-34} \text{m}^2 \text{kg/s}$, $\mu_0 = 4\pi \times 10^{-7} \text{Tm/A}$, $1 \text{eV} = 1.6 \times 10^{-19} \text{J}$.

QUESTION ONE (COMPULSORY) (30 MARKS)

- Identify any four factors affecting the optimal tilt of a solar panel for a month. (4 marks)
- Discuss any two examples of catastrophic accidents that have occurred in the use of nuclear energy as an energy resource (4 marks)
- Identify ways in which Kenya can reduce the impact of energy resource harvesting and production to the degradation of the environment (4 marks)
- In what ways can the solar panels be mounted? (2 marks)
- Define the terms;
 - Irradiance (2 marks)
 - Pyrolysis (2 marks)
- Identify the criteria used in choosing which materials are best suited for a solar cell. (3 marks)
- Calculate the radiation from the sun at 5790°C ? (2 marks)
- Based on their working principles, identify the three types of geothermal power plants. (3 marks)
- List any four components of the balance of system in solar PV system. (4 marks)

QUESTION TWO (20 MARKS)

- a) Describe the working principle of a solar thermal power system. (4 marks)
- b) Discuss how advances in energy technologies has enhanced sustainable development in Kenya. (4 marks)
- c) Using a sketch, discuss the major parts of a wind energy system. (6 marks)
- d) Describe resource formation, harnessing and electricity generation of the following types;
 - i) Coal (3 marks)
 - ii) Natural gas (3 marks)

QUESTION THREE (20 MARKS)

- a) You recently purchased a solar collector for your client. While using a drawing, identify and describe the different parts of a solar collector. (5 marks)
- b) Describe the two forms of solar trackers (4 marks)
- c) Identify any four long-term strategies that can be used to enhance energy conservation. (4marks)
- d) Describe the photovoltaic effect (7 marks)

QUESTION FOUR (20 MARKS)

- a) Describe any three factors affecting the output of wind power. (6 marks)
- b) Name the three types of Silicon-based PV cells. (3 marks)
- c) Kamau intends to install a solar power system in his home for domestic use and water-pumping but he is torn between using the already available KPLC connection and having his individual power. Identify the convincing major factors that will influence the design of his solar PV array. (3 marks)
- d) Discuss the disadvantages of the following energy resources
 - i) Bioenergy (3 marks)
 - ii) Geothermal (3 marks)
 - iii) Coal (2 marks)

QUESTION FIVE (20 MARKS)

- a) Show that the power of a wind turbine is given by;

$$P = \frac{1}{2} \rho A v^3 \quad (10 \text{ marks})$$

Where ρ is the density, A is the sweep area and v is the speed of wind

- b) Discuss energy conversion and generation using the following technologies
 - i) Hydroelectricity (5 marks)
 - ii) Bioenergy (5 marks)