



MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (APPLIED PHYSICS AND TECHNOLOGY)

SPH357: RENEWABLE ENERGY TECHNOLOGY

DATE: 24/8/2022

TIME: 8.30-10.30 AM

INSTRUCTIONS:

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

You may need to use;

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

$\sigma = 5.7 \times 10^{-8} \text{ W/m}^2 \text{ K}^4$

QUESTION ONE (30 MARKS)

- a) Name any three feedstock for bioenergy (3 marks)
 - b) Describe the disadvantage of using biofuels (3 marks)
 - c) Differentiate between the terms insolation and irradiance (2 marks)
 - d) List the four parts of a Solar PV system (2 marks)
 - e) Identify the factors affecting the optimal tilt of a solar panel for a month. (2 marks)
 - f) Name the two agencies mandated with regulation of standards and global energy. (2 marks)
 - g) Differentiate between renewable and non-renewable resources (2 marks)
 - h) List four (4) mechanisms of heat transfer (2 marks)
 - i) Define the following terms and devices;
 - i. Photovoltaic cell (2 marks)
 - ii. Albedo effect (2 marks)
 - iii. Heliostat (2 marks)
 - j) Identify any three types of solar thermal power plants (3 marks)
 - k) If the current global energy consumption is 651 Quadrillion BTUs, determine the projected energy consumption after in 2056? (3 marks)
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QUESTION TWO (20 MARKS)

- a) Describe the general working principle of a thermal power system. (7 marks)
- b) A planetary body emits a wavelength at 5795°C. Calculate the amount of radiation produced (4 marks)
- c) Describe resource formation, harnessing and electricity generation of the following types of resources of energy
 - i. Coal (3 marks)
 - ii. Biogas (3 marks)
 - iii. Nuclear (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) While labelling, sketch the current-voltage curve for a solar cell. (4 marks)
- c) Identify any three disadvantages of solar cells. (3 marks)
- d) Describe the process of photovoltaic effect (8 marks)

QUESTION FOUR (20 MARKS)

- a) Name the three types of Silicon-based PV cells. (3 marks)
- b) Owino 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)
- c) Discuss the various factors affecting the amount of solar radiation reaching the earth's surfaces (8 marks)
- d) Differentiate between the following solar PV systems;
 - i. Battery-based grid-tied (3 marks)
 - ii. PV direct (3 marks)

QUESTION FIVE (20 MARKS)

- a) Describe the process of greenhouse gas effects on climate change (10 marks)
- b) Discuss energy conversion and generation using the following technologies
 - i. Hydroelectricity (5 marks)

ii. Geothermal energy

(5 marks)