



MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (APPLIED PHYSICS AND TECHNOLOGY)

SPH 458: BIOMASS ENERGY TECHNOLOGY

DATE: 30/8/2022

TIME: 2.00-4.00 PM

INSTRUCTIONS:

- The examination consists of **FIVE** questions. Answer question **ONE** and any other **TWO** questions

QUESTION ONE (30 MARKS)

- Write an equation showing how plants convert sunlight into chemical energy (2 marks)
 - Define the following terms as used in Biomass energy
 - Biomass (2 marks)
 - Feedstock (2 marks)
 - Gasification (2 marks)
 - List 4 examples of edible crops that can be used in production of biodiesel. (4 marks)
 - Give two examples of syngas (2 marks)
 - Explain how the following aspects are a challenge in biomass energy
 - Moisture content of biomass (3 marks)
 - Energy density of biomass (3 marks)
 - Give four ways in which municipal waste can be upgraded. (4 marks)
 - Explain why second generation energy crops are not the best as feed stock (2 marks)
 - Give two reasons why third generation feedstock are the most promising in biomass energy production (2 marks)
 - When we burn firewood, a lot of smoke is produced which damage the environment. Why is it then said that biomass is the future energy source. Give two reasons (2 marks)
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QUESTION TWO (20 MARKS)

- a) With aid of a well labelled diagram describe the gasification process (5 marks)
- b) Explain how gasification is better than biogas and biodiesel (6 marks)
- c) Plasma technology is used in production of energy from biomass. Explain how it works (4 marks)
- d) Distinguish thermo chemical and biochemical biomass energy processes (5 marks)

QUESTION THREE (20 MARKS)

- a) Justify the statement “biomass gasification is carbon neutral and does not harm the environment” (5 marks)
- b) Waste gasification has several principal advantages over incineration, list 5 advantages (5 marks)
- c) Explain one major challenge for waste gasification technologies (5 marks)
- d) Municipal waste gasification process presents significant advances over garbage incineration. Give three reasons (3 marks)
- e) Distinguish fast pyrolysis from gasification (2 marks)

QUESTION FOUR (20 MARKS)

- a) Distinguish between gasification from anaerobic digestion plant (4 marks)
- b) Explain the Biomass Transesterification chemistry. (5 marks)
- c) With a well labelled diagram show a plug flow bio digester design and state one advantage associated with it (5 marks)
- d) Partial biomass oxidation is a process used to form syngas.
 - i. Explain what it is (1 mark)
 - ii. Explain the chemistry of partial biomass oxidation (4 marks)
 - iii. State one of its advantages (1 mark)

QUESTION FIVE (20 MARKS)

- a) “Waste is not only an environmental problem, but also an economic loss” what is your opinion on this? (4 marks)
- b) When we burn firewood, a lot of smoke is produced which damage the environment. Why is it then said that biomass is the energy source for the future. Explain two reasons. (6 marks)
- c) Describe the chemistry involved in a gasification process (6 marks)
- d) List two advantages and disadvantages of Fast Pyrolysis (4 marks)