



UNIVERSITY OF
KWAZULU-NATAL
INYUVESI
YAKWAZULU-NATALI

SCHOOL OF ENGINEERING

MAIN EXAMINATIONS: JUNE 2019

COURSE AND CODE: BIOREFINERY CONCEPTS AND GREEN TECHNOLOGIES
ENCH4BG

DURATION: 2 HOURS

TOTAL MARKS: 100

INTERNAL EXAMINER(S): DR M MKHIZE
MRS N MASEKO
PROF A STARK

INTERNAL MODERATOR(S): DR D LOKHAT

EXTERNAL MODERATOR: A/PROF K HARDING

INSTRUCTIONS:

1. ALL questions should be attempted.
2. Any programmable or non-programmable calculator may be used provided it has been cleared of any information that would subvert the purpose of the examination.
4. Calculations must be shown in sufficient detail to illustrate your understanding of the procedure.
5. This examination question paper, together with all associated diagrams **MUST BE HANDED IN TOGETHER WITH YOUR SCRIPT.**

Student Number:

QUESTION 1 - LIFE CYCLE ASSESSMENT AND BIOMASS FRACTIONATION

- 1.1 Give a definition of sustainability in the context of biorefining. (5)
- 1.2 What is the purpose of a Life Cycle Analysis (LCA)? (2)
- 1.3 Name 4 typical impact categories assessed in LCA. (2)
- 1.4 There are certain advantages and disadvantages of a full Life Cycle Analysis (LCA) when compared to a simplified method of assessing the environmental sustainability (simplified LCA). Name 4 advantages and 4 disadvantages. (4)
- 1.5 Describe three processes to fractionate lignocellulose to obtain cellulose for 2nd generation ethanol production. When comparing these three processes by means of a Life Cycle Analysis, one process performs better than the others. Name four aspects why this is the case. (7)

TOTAL /20/

QUESTION 2 - FATS AND OILS IN THE CHEMICAL INDUSTRY

- 2.1 Name 5 typical feedstock sources for fats and oils, and 5 products from fats/oils. (5)
- 2.2 Discuss 5 advantages and 5 disadvantages when using fats/oils for industrial applications. (5)
- 2.3 Describe the process of making soap with a flow scheme, and indicate what happens at each of the 5 main stages. (10)

TOTAL /20/

QUESTION 3 – BIOFUELS AND SYNTHETIC FUELS

- 3.1 In terms of the production of biofuels, how does the thermochemical treatment differ from the biological treatment? What added advantage does this treatment method consist? (3)
- 3.2 Name and define two thermochemical routes that are mainly used to extract energy from biomass. List at least two advantages of each method. (6)
- 3.3 What is a hydro-deoxygenation process? Which type of biofuel is it used to produce? Name at least one feedstock used in this process. (3)
- 3.4 Using a block flow diagram, describe the typical process of producing nanocellulose. (4)
- 3.5 What is microcrystalline cellulose? Name at least two of its users. (4)

TOTAL /20/

QUESTION 4 - BIOGAS

- 4.1 What does biogas mainly comprise of? (2)
- 4.2 What is lignocellulosic biomass? Which one of its components makes this biomass difficult to process and why? (3)
- 4.3 Lignocellulosic biomass is usually pre-treated before it can be utilized. Name three different types of its pre-treatment and describe what happens during each process. (9)
- 4.4 Name the main production method of biogas and list at least two of its steps and describe what happens in each of the steps. (4)
- 4.5 List two advantages of biogas production. (2)

TOTAL /20/

QUESTION 5 - CHEMICAL LEASING

- 5.1 What is chemical leasing? (2)
- 5.2 Using three examples, discuss applications of chemical leasing. (10)
- 5.3 Name 2 advantages and 2 disadvantages of chemical leasing. (8)

TOTAL /20/