

# MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

FACULTY OF ENGINEERING

Department of Chemical and Processing Engineering

FUELS AND ENERGY

CODE: HCHE 523

SESSIONAL EXAMINATIONS

MARCH-APRIL 2021

DURATION: 3 HOURS

EXAMINER: Dr B.C. NYAMUNDA

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## ***INSTRUCTIONS***

- 1. Answer any **four** questions*
  - 2. Total marks 100*
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### QUESTION 1

- a) Describe the *disadvantages* and *advantages* of the following intermediate and small scale stationary/mobile storage of hydrogen:
- i. Liquid form [3]
  - ii. Metal hydrides [3]
- b) Outline the inherent *advantages* of hydrogen fuels compared to combustion engines. [4]
- c) What is a fuel cell? [1]
- d) With aid of a diagram describe the operation of a polymer electrolyte fuel cell. [10]

### QUESTION 2

There are various forms of renewable energy. Most of these renewable energies depend in one way or another on sunlight.

Identify the *merits* and *demerits* of the following forms of renewable energy

- a) Wind energy [15]
- b) Hydro energy [10]

### QUESTION 3

- a) Fischer–Tropsch process is a fully developed and exploited technique in solving energy issues in South Africa.
- i. Identify **two** scientists who developed this process and their country of origin. [3]
  - ii. What does the Fischer–Tropsch process achieve? Give **two** balanced chemical equations representing the process of producing octane and heptene. [3]
  - iii. Name four catalysts that are used for the process. [2]
  - iv. What temperature and pressure are employed during the Fischer–Tropsch process? [2]
- b) Coal gasification make use of surface and underground gasifiers.
- i. Describe the principles behind entrained flow reactors surface gasifiers. [5]
  - ii. Describe the principles behind controlled retraction injection point (CRIP) from oil technology underground gasifiers. [5]
- c) Briefly describe the operation of a heat pump. Give two examples of heat pumps. [5]

#### QUESTION 4

With the aid of schematic diagrams, explain the principle behind the following units

- a) Steam turbines [12]
- b) Combined heat and power systems [13]

#### QUESTION 5

- a) Coal produced at Hwange colliery mine is classified into high and low ranks.
  - i. Distinguish high rank coals from low rank coals. [6]
  - ii. Give **two** examples **each** of low and high rank coals [4]
  - iii. With respect to coal what do you understand by the term coal fusion temperature? [1]
  - iv. Define *wetearability index* and *grindability index* as applied to coal. [2]
- b) Coal tar is a byproduct of coal gasification. It is subjected to fractional distillation to produce useful chemicals.
  - i. Identify any **five** products of coal tar fractional distillation and **one** use of each. [10]
  - ii. What is meant by *allothermal* and *autothermal* processes during coal gasification? [2]

**END OF EXAM**