KENYATTA UNIVERSITY

EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE PETROLEUM ENGINEERING

EPL 509: STRATEGIC ENERGY ISSUES

1ST SEMESTER 2022/2023 TIME: 2 HOURS

INSTRUCTIONS:

- **This paper consists of FIVE Questions.**
- **Answer Question ONE and any other TWO.**

QUESTION ONE (COMPULSORY) – 30 MARKS

(a) The global energy crisis underscores the need for policy to align energy security needs with climate goals. Russia's invasion of Ukraine in February 2022 marked a turning point in global energy markets. Energy costs are surging and the impacts of this crisis are far reaching. This has heightened attention on the energy security. As an energy expert discuss available options and how policy changes could address this crisis. **(8 marks)**

(b) Explain the difference between energy conservation and energy efficiency. **(2 marks)**

(c) Energy efficiency and conservation measures have the potential to scale down capital investments needed to provide additional supplies and reduce overall resource use. It also has the potential of reducing cost of production at the end user. Discuss the major challenges that have hindered the maximum realization of the benefits of energy efficiency in Kenya. **(5 marks)**

(d) The momentum behind hydrogen as an energy carrier continues to be strong. It has been recognized as a key option to realize the net zero greenhouse gas emissions commitments that governments have announced in recent years. Discuss FIVE key policy recommendations as proposed to governments by International Energy Agency (IEA) to promote production and use of low emission hydrogen. **(10 marks)**

(e) Uranium – 235, $(^{235}_{92}U)$ is the main naturally occurring fuel used in nuclear reactors. Discuss the Nuclear fuel cycle and nuclear waste processing/handling. **(5 marks)**

QUESTION TWO (20 MARKS)

(a) Hydrogen is one of the technology pillars on which hopes to abate the current challenges of climate change and de-carbonization of the energy sector. In reference to the statement:

i. Explain the attraction to hydrogen as an energy carrier and how it's been traditionally produced and stored. **(6 marks)**

ii. Explain the terms Grey hydrogen, Brown hydrogen, Blue hydrogen and Green hydrogen. **(4 marks)**

(b) Explain the uses of hydrogen under the following headings:

i. Hydrogen in industrial sector

ii. Hydrogen in transport sector

iii. Hydrogen in power sector

(7 marks)

(c) Explain the significance of hydrogen production with CCUS. **(3 marks)**

QUESTION THREE (20 MARKS)

(a) Differentiate the following giving examples:

i. Conventional and non-conventional energy resources

ii. Sustainable and renewable energy resources

iii. Primary and secondary energy

(6 marks)

(b) Explain the term carbon capture, utilization and storage (CCUS) and briefly outline why the growing interest in CCUS. **(4 marks)**

(c) Describe FOUR different approaches that are being investigated to capture carbon dioxide and store it away from the atmosphere. **(6 marks)**

(d) From your assessment, explain the major challenges with CCUS. **(4 marks)**

QUESTION FOUR (20 MARKS)

(a) Discuss the major components of the *'Energy Triliema'* that the world is currently facing as identified by the World Energy Council. **(7 marks)**

(b) In your opinion, discuss the role of renewable energy in the contribution to the global energy matrix and if renewable energies are likely to make a major contribution to the global energy budget as projected. **(7 marks)**

(c) Energy conservation can play a significant role in the management of our resources. What contribution can energy efficiency make to reducing global CO_2 emissions?

(6 marks)

QUESTION FIVE (20 MARKS)

Global emissions of energy-derived carbon dioxide are expected to increase by another 20% by 2035 according to the International Energy Agency (IEA). Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) found that global warming is an indisputable fact and that in order to curb climate change, it will be necessary to make fundamental and continuous efforts to reduce greenhouse gas emissions.

Discuss the following:

(a) Environmental Impacts of Energy generation and utilization. **(8 marks)**

(b) Approaches necessary to reduce green house gas emissions. **(6 marks)**

(c) Measures that have been proposed to mitigate the effect of Climate Change. **(6 marks)**