UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

DEPARTMENT OF GEOGRAPHY, ENVIRONMENTAL MANAGEMENT & ENERGY STUDIES

MODULE **ENS0057**
ENERGY MODELLING

CAMPUS **APK**

EXAM **NOVEMBER 2015**

DATE **12 NOVEMBER 2015** **SESSION** **08:30 – 11:30**

ASSESSOR(S) **DR JOHN LEDGER**

EXTERNAL MODERATOR **DR D. MARAIS**

DURATION **3 HOURS** **MARKS** **100**

NUMBER OF PAGES: 2 PAGES

INSTRUCTIONS:

Please answer QUESTION 1 and TWO of the remaining FOUR questions. Each answer should be in the form of a comprehensive essay, with sketches and diagrams where these may be appropriate to enhance your answer. Alternatively you may provide your answer in point form. Each answer is worth the same number of marks (33.3%)

QUESTION 1 (COMPULSORY)

1. Solar Water Heating Model. A home owner has a 150 litre electrical geyser to provide hot water to his house. He decides to invest in alternative energy sources to generate hot water for domestic use. He develops a design of a system consisting of a solar water heater (also 150l capacity) which feeds into a gas-fired heater that has a control system that will produce hot water at a pre-set temperature. The gas-fired heater will then discharge into the electrical geyser. The goal of the home owner is to shut down the supply of electricity to the old geyser and thereby paying back the investment in the solar water and gas-fired heaters.

    - Explain how a model could be structured to assist the home owner in establishing the economic viability of the proposed design by stating the relevant input, output and process factors that will determine the success of the proposed system. Discuss the qualitative impact that these factors may have on the decision whether or not to go ahead with the proposed design.

    - Describe the extreme conditions of operation that the home owner will have to consider and suggest ways to mitigate the operational risks.

[33.3]

QUESTION 2

2. System Dynamics. You have attended a course on System Dynamics.

a). Provide two examples of systems and explain how the elements interconnect.

b). Explain the Iceberg model.

c). List five rules for drawing Causal Loop Diagrams (CLD).

[33.3]

QUESTION 3

3. Electricity Costing. Discuss the concepts of ‘Overnight Costs’ and ‘Levelized Costs of Electricity’ and describe how you would construct various models to demonstrate to decision-makers that certain electricity generation technologies have advantages/disadvantages over others

[33.3]

QUESTION 4

4. Flow Diagram. A South African bakery is considering the possible of introducing renewable energy into its existing conventional energy mix. The cost of electricity is rising and a carbon tax is to be introduced. Build a high level flow diagram demonstrating the different phases of energy transfer at present and demonstrate what would change with the integration of renewable energy. Reference the resource on the left of the flow diagram and the demand on the right.

[33.3]

QUESTION 5

5. A chicken farm has a five year contract to supply eggs and fresh chickens to Woolworths supermarkets until 2029. Their financial consultants have warned that due to its remote location, rising operational costs could push the company into the red before then. A major part of the costs relate to electricity for the factory and fuel for the delivery fleet of 20 refrigerated trucks. Based on this information, discuss which of the three energy models listed below you would use to optimize the cost and efficiency of the operation, and why. Provide a flow diagram to indicate the different energy solutions that might be introduced to contain operational costs.

General equilibrium models Focus: microeconomic; Energy system detail: low level; System boundaries: entire economy; Timeframe: MT - LT
Input-output models Focus: macroeconomic; Energy system detail: low level; System boundaries: entire economy; Timeframe: ST - MT
Optimisation models Focus: technological energy systems with cost structures; Energy system detail: high level; System boundaries: energy system; Timeframe: ST - LT

[33.3]

TOTAL [100]