STRATHMORE UNIVERSITY
SCHOOL OF COMPUTING AND ENGINEERING SCIENCES
MASTER OF SCIENCE IN SUSTAINABLE ENERGY TRANSITIONS
END OF SEMESTER EXAMINATION
MSSET 8204
ENERGY SYSTEMS ANALYSIS AND DECISION MAKING

DATE: 24 April, 2023 **Time: 2.5 Hours**

Instructions: Answer question one (Compulsory) and two other questions

QUESTION 1

a. Discuss the components of the total cost of an energy technology [**6 Marks**]

b. Explain what Capacity to Activity Unit is and calculate its value [**4 Marks**]

c. Describe the role of Linear Programming in energy system analysis and decision making [**2 Marks**]

d. Illustrate how Total Technology Annual Activity Upper Limit or Total Technology Model Period Activity Upper Limit as used in OseMOSYS may affect the capacity factor of a power plant [**5 Marks**]

e. In OSeMOSYS tool, explain the differences between Specified-Annual-Demand and Accumulated Annual Demand. [**3 Marks**]

(Total Marks: 20)

QUESTION 2

a. Illustrate a Reference Energy System (RES) that features Hydro, Nuclear, coal and biomass that are used for generating electricity. The RES should illustrate the full chain from commodities to demand. Consider demand from Residential, Commercial and Industrial users. [**10 Marks**]

b. With respect to a nuclear power plant, explain the relevance as well as relationship among the following energy technology parameters: Efficiency, Input Activity Ratio and Output Activity Ratio [**3 Marks**]

c. If the input activity ratio of a technology is 3.03, calculate its efficiency [**2 Marks**]

(Total Marks: 15)

QUESTION 3

a. Analysis of the electricity system for a small country in Southern Africa shows the occurrence of unpredictable power failures that have been linked to sudden spikes in demand.

   i. Explain the role of reserve margin in energy planning. [**2 Marks**]

   ii. Evaluate two electricity generation technologies that the country can deploy easily ramp up and down the generation capacity, considering a timeframe of 3 months to 15 years [**5 Marks**]

b. Design an electricity generation plan for a small town, based on the following requirements and constraints. The minimum power demand is 120 Mega Watt (MW), and maximum allowed yearly emissions are 9 Giga Tonnes (GT). Two fuel technologies are available for electrical power generation. A power plant using fuel ***A*** generates 15 MW of power with yearly emissions of 5 GT, while a plant using fuel ***B*** generates 20 MW of power with yearly emissions of 3 GT. A plant using fuel ***A*** can supply 10 commercial consumers, while that using fuel ***B*** can supply 15. Determine the fuel combination that will supply the maximum number of industrial consumers [**8 Marks**]

(Total Marks: 15)

QUESTION 4

a. Describe OSeMOSYS and provide examples of how it has been used in energy planning. [**3 Marks**]

b. Evaluate the main strengths and weaknesses of OSeMOSYS as an energy planning tool as compared to other energy system models in terms of its capabilities and limitations [**6 Marks**]

c. Discuss how OSeMOSYS can be used to evaluate the environmental impacts of different energy systems and give some of the key metrics used to assess environmental performance. [**6 Marks**]

(Total Marks: 15)