



**STRATHMORE UNIVERSITY**  
**SCHOOL OF COMPUTING AND ENGINEERING SCIENCES**  
**MASTER OF SCIENCE IN SUSTAINABLE ENERGY TRANSITIONS**  
**END OF SEMESTER EXAMINATION**  
**MSSET 8102: SUSTAINABLE ENERGY SYSTEMS AND SOCIETY**

**DATE: 27<sup>th</sup> August 2024**

**Time: 18:00-20:30 Hours**

---

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

**QUESTION 1 [20 Marks]**

- a. Conduct an assessment of below sources of energy for the generation of electrical power using the criteria of plant setup requirements and impact on environment.
- i. Hydro [4 Marks]
  - ii. Wind [4 Marks]
  - iii. Coal [4 Marks]
- b. Development of various forms of primary energy e.g. crude oil and natural gas is important for sustainability of countries in sub-Saharan Africa. Currently most of countries in the region import refined products even though they export crude oil and other unrefined products. Discuss the strategy governments in the region can adopt to achieve an energy secure future and sustain their economic development goals. [5 Marks]
- c. Demand for energy e.g. electricity, coal, gas, diesel and petrol arises from sectors such as residential, commercial, industrial and transport. Select one sector and discuss how a combination of two or more of the energy sources can be used to meet demand for the sectors while minimizing adverse impact to the environment. [3 Marks]

**QUESTION 2 [15 Marks]**

- a. Explain the role of energy access in poverty alleviation. [5 Marks]
- b. Explore policies that sub-Saharan Africa (SSA) countries can adopt in order to develop their primary energy resources such as crude oil and natural gas and achieve sustainable development of their societies. [5 Marks]
- c. Members of the society can be impacted by development of energy systems. This can be in the form of displacement from their homes or exposure to toxic pollutants. Discuss recommendations that should be considered when approving installation of a Liquefied Natural Gas (LNG) power plant, with respect to impact to society and power transmission requirements. [5 Marks]

**QUESTION 3 [15 Marks]**

- a. Pumped storage is a form of hydroelectric power that depends on excess power generated during off-peak hours to replenish upstream dams with water that is then used to drive power generation turbines, that are installed between upstream and downstream dams, during peak hours. Ingula

Pumped Storage Scheme in South Africa supplies 1332 MW of electricity to the grid during peak hours. Illustrate the design and operation of pumped storage systems and discuss advantages of pumped storage hydropower, while explaining how such systems can be designed to support near 100% renewable power. **[10 marks]**

- b. The Kariba dam in Zambia and Zimbabwe is an important source of renewable hydroelectric power with an expected lifetime of over 100 years. Discuss challenges that limit the expansion of hydropower projects in sub-Saharan Africa. **[5 Marks]**

**QUESTION 4 [15 Marks]**

- a. Describe the key factors that drive energy demand in residential households in sub-Saharan Africa. **[5 Marks]**
- b. The drivers of energy demand should be considered when planning for a sustainable energy future. Some of the many categories of drivers of energy demand are industrial, transportation, and residential. In a country where the population of people is expected to reach 70 million in the next 20 years, discuss how it can achieve the level of 70% clean cooking and transportation. Assume the country has access to several forms of primary energy including natural gas, uranium deposits, coal deposits, and 95% sunshine exposure throughout the year. Note: currently the country's population depends on bio-mass for 95% of cooking energy. **[10 Marks]**