KENYATTA UNIVERSITY

EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN ENGINEERING (ENERGY, GAS AND PETROLEUM ENGINEERING)

TET 407: ENERGY PLANNING, POLICY & TRADING

1ST SEMESTER 2023/2024 TIME: 2 HOURS

INSTRUCTIONS:

Answer Question ONE and any other TWO Questions

Question ONE carries 30 marks and all the others carry 20 marks each

Useful Expressions

$$UC_{util} \times W_{av} \times n = FC + \left(UC_{prod} \times W_{av} \times n\right)$$

$$LCOE = \frac{sum\ of\ costs\ over\ lifetime}{sum\ of\ electrical\ energy\ produced\ over\ lifetime} = \frac{\sum_{t=1}^{n} \frac{I_t + M_t + F_t}{(1+r)^t}}{\sum_{t=1}^{n} \frac{E_t}{(1+r)^t}}$$

Question 1 (Compulsory) - (30 marks)

[a] Highlight various levies associated with petroleum product prices in Kenya *(3 marks)*

[b] Discuss various aims of Energy Planning at macro level *(4 marks)*

[c] Define Energy Policy *(2 marks)*

[d] Discuss the general structure of energy planning models and give two (2) examples of energy planning models *(7 marks)*

[e] Discuss sources of suitable energy investment projects *(3 marks)*

[f] From a broader perspective, explain the various potential benefits of investing in a renewable energy project *(5 marks)*

[g] Discuss at least four (4) energy investment appraisal techniques *(6 marks)*

Question 2 - (20 marks)

[a] A farmer in a rural setting decides to purchase a generator rated 50 kW to help in pumping water for irrigation. The generator has a capital cost of KShs. 18,000,000. The cost of producing each unit of electricity is KShs. 27/kWh. The annual output is 268 MWh and the maintenance costs are KShs. 35,000 per annum.

(i) What is the total cost of the generator unit considering a lifetime of 6 years? *(4 marks)*

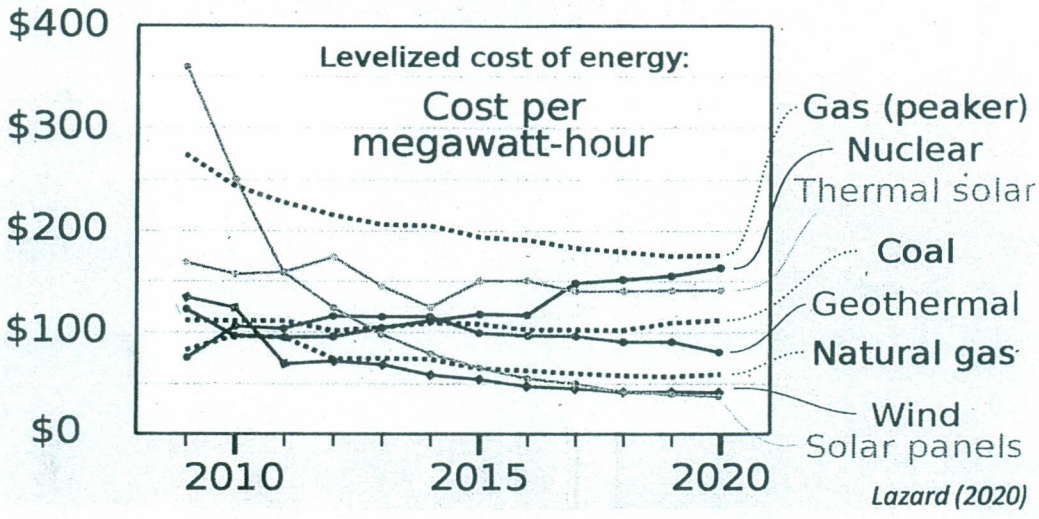
(ii) If the facility buys power from the utility at KShs. 42/kWh, determine the break-even point of the generator? *(6 marks)*

[b] Discuss types of demand side energy management *(4 marks)*

[c] Compare Net metering and Renewable Energy Quarter system *(6 marks)*

Question 3 – (20 marks)

[a] The figure hereunder shows various trends in LCOE of various fuels



i. Explain your understanding of LCOE *(4 marks)*

ii. Comment on the LCOE for Nuclear and Wind energy *(3 marks)*

[b] Discuss the energy policy making process *(8 marks)*

[c] In your understanding, clearly differentiate Payback Period from Break Even Point *(5 marks)*

Question 4 – (20 marks)

[a] Local authorities have a responsibility of ensuring adequate energy services in the cities. However, most activities in the city require energy and many of them are very energy intensive. Discuss at least five (5) activities/areas where the city could pay keen attention in urban planning *(10 marks)*

[b] A company borrows KShs. 700,000 to purchase a new generator for installation. If the interest rate is 8.5% per annum and the repayment period is 6 years, compare the value of the total repayment assuming; (i) simple interest is applied, and if (ii)

compound interest is applied.

(6 marks)

[c] Discuss three examples of rural energy planning computer based tools *(4 marks)*

Question 5 – (20 marks)

[a] Demand estimation is a very important element in energy planning. Briefly discuss Load factor, Demand factor, Capacity factor, Utilization factor and then discuss drivers of energy demand. *(10 marks)*

[b] Explain various categories of potential donors and funders of Energy investments and further give reasons to why financing Renewable energy and Energy Efficiency project is sometimes limited. *(10 marks)*