



UNIVERSITY EXAMINATIONS
FOURTH YEAR EXAMINATION FOR THE AWARD OF
THE DEGREE OF BACHELOR OF SCIENCE IN RENEWABLE ENERGY

SECOND SEMESTER 2021/2022
(FEBRUARY – JUNE, 2022)

PHRE 423: ENERGY MANAGEMENT

STREAM: Y4 S2

TIME: 2 HOURS

DAY: WENESDAY, 12:00 PM – 2:00 PM

DATE: 18/05/2022

INSTRUCTIONS

- 1. Do not write anything on this question paper.***
- 2. Answer Question ONE (Compulsory) and any other TWO Questions.***

QUESTION ONE

- What is energy management? [1 mark]
- State three objectives of energy management. [3 marks]
- What is energy audit? [1 mark]
- State three things that the type of audit to be performed depends on. [3 marks]
- Detailed energy auditing is carried out in three phases. Briefly discuss the steps. [3 marks]
- State any three factors should be taken into account during procurement of fuels for energy efficiency and economics. [3 marks]
- State any four factors that are involved in deciding final cost of purchased electricity. [4 marks]
- State any four comparative factors which need to be looked into when doing external energy benchmarking. [4 marks]
- State any three key instruments that should be used during energy audit. [3marks]

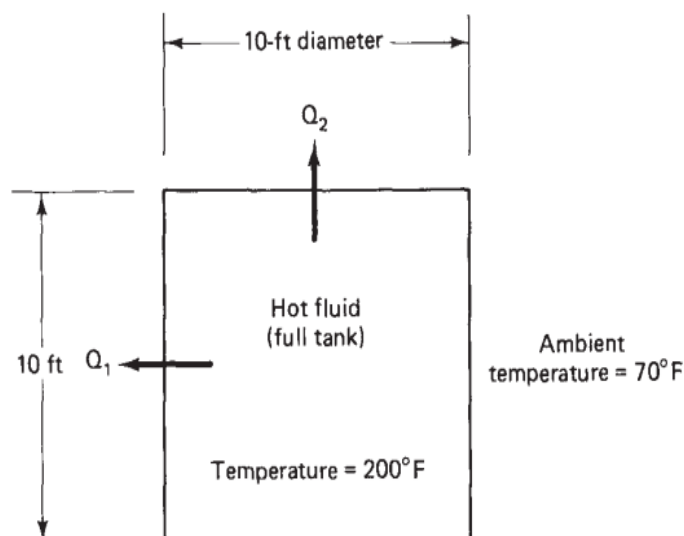
- j. What do you understand by the term fuel substitution? Give examples.
[1marks]
- k. State any three measures that could be put in place to optimize the energy input requirements. [3 marks]

QUESTION TWO

- a. Briefly explain what is de-lamping and re-lamping. [2 marks]
- b. “Once the energy usage and sources are matched properly, the next step is to operate the equipment efficiently through best practices in operation and maintenance as well as judicious technology adoption”. Give some four illustrations in this context. [4 marks]
- c. State two examples of energy substitution. [2 marks]
- d. Calculate the annual savings from replacing 40-watt F40T12/Workshop lamps with 34-Watt energy-saving lamps in two hundred (200) 4-lamp fixtures which are operated continuously. Assume the following: The F40T12/Workshop lamps cost Ksh100 each and last for 12,000 hours. The 34-Watt F40T12 lamps cost Ksh150 each and last for 20,000 hours. Electric energy costs Ksh5 per kWh. The demand charge is Kshs550 per kW per month. The facility is not air conditioned. [12 marks]

QUESTION THREE

- a. Briefly discuss the following terms as used in insulation theory; Thermal conductivity, Thermal resistance and Conductance. [3 marks]
- b. Discuss the three modes of heat transfer and state any one way that we can minimize each. [6 marks]
- c. Assume we have a 1/2-inch-thick uninsulated mild steel tank storing a hot fluid as shown in Figure 1. (The K value for mild steel is 314.44 Btu.in/(ft². h. °F)). The fluid is heated to 200°F, while ambient air is 70°F.



Fig

- i. What is the heat loss for the uninsulated tank? Ignore the heat loss to the ground. Also assume surface temperature of 120°F, and surface film coefficient R_s of 0.5 h. ft². F/Btu. [4 marks]
- ii. Assume that an aluminium-Jacketed fiberglass insulation 1 inch thick is added so that it covers the tank. Determine the new heat loss, heat saved and percentage save. [4 marks]
- iii. What would be the percentage heat save if a 2 inch of insulation was used? [3marks]

QUESTION FOUR

- a. Jumbo Industries has a 50-hp air compressor that operates at full-load, all day for 365 days per year. If the motor for the air compressor cost Kshs140,000, the motor efficiency is 90%, and electricity costs Kshs700/kW/month and Kshs5/kWh, how much does it cost to operate the air compressor for one year? (assumethat if the motor were 100% efficient, there would be an electric load of 0.746 kW/hp) [6 marks]
- b. How much money will be spent to operate the air compressor over a ten-year period? [2 marks]
- c. Jumbo Industries has been experiencing a period of rapid growth in the success of their products, and they plan to expand their production capacity by building a second plant nearby. They determine that they need another 50-hp air compressor which will also run continuously at full load. They can purchase either the Standard or the Deluxe Model air compressor with the difference being that the Deluxe Model has a high efficiency motor. The motor efficiency for the Standard Model is 91.5%, and for the Deluxe Model it is 93.8%. The additional cost for the Deluxe Model is Kshs47,000. Is this a good investment for Jumbo Industries? [7marks]
- d. Jumbo Industries also wants to know what kind of “cushion” they have on this decision, since their forecast for new business could be too optimistic. If the new air compressor is only run for two shifts a day, for a total of 5000 hours per year, is the additional investment still worthwhile? [5 marks]

QUESTION FIVE

- a. By using electricity, fuel cost and coal as your type of energy, make a typical summary of energy purchased in an industry based on the invoices. [5 marks]
- b. State any five purposes that energy invoices can be used for in energy management. [5 marks]
- c. Name eight types of information that should be collected during the audit visit. [8 marks]
- d. State any two things that technical feasibility should address during the auditing process. [2 marks]