



JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

**UNIVERSITY EXAMINATION FOR THE DEGREE IN SCIENCE IN RENEWABLE
ENERGY TECHNOLOGY AND MANAGEMENT**

4TH YEAR 1ST SEMESTER 2024/2025 ACADEMIC YEAR

CENTRE: MAIN CAMPUS

COURSE CODE: TEB 1405

COURSE TITLE: ENERGY CONSERVATION AND MANAGEMENT

EXAM VENUE: STREAM: BSc. REN ENGY TEC & MGT

DATE: 6/1/2025 EXAM SESSION: 14-16.00 HRS

DURATION: 2 HOURS

Instructions

- 1. Answer question 1 (Compulsory) and ANY other two questions**
- 2. Candidates are advised not to write on question paper**
- 3. Candidates must hand in their answer booklets to the invigilator while in the examination room.**

Question One (Compulsory)

- a) The energy cost to operate electric motors can be a significant part of the operating budget of any commercial and industrial building. Outline **FOUR** measures that could be adopted to reduce the energy cost of using motors. **(4 Marks)**
- b) Outline **TWO** versions outlined by ASHREA 90 standards of energy codes used for buildings. **(2 Marks)**
- c) Enumerate **FOUR** major systems an energy auditor would consider when planning for an energy audit the cement manufacturing company based in Muhuroni. **(4 Marks)**
- d) List **SIX** types of energy typically used an energy auditor would consider while performing energy audit. **(3 Marks)**
- e) Calculate how many kJ are in 10kWh **(2 Marks)**
- f) A 1000m² building consumes the following amounts of energy per year.
Natural gas 500GJ/year
Electricity 60,000 kWh/year
Determine what is the energy use index per year in MJ m²/year **(3 Marks)**
- g) A company borrows £ 50 000 to finance a new boiler installation. If the interest rate is 9.5% per annum and the repayment period is 5 years, determine the value of the total repayment and the monthly repayment value, assuming:
- That simple interest is applied. **(2 Marks)**
 - That compound interest is applied. **(2 Marks)**
- h) During an energy audit exercise you found that continuous use of lights in a washroom resulted to huge energy losses. Outline **THREE** methods that could be used for automatic light control system for the wash room situated in a busy premise. **(3 Marks)**
- i) Consider a building with total 500 luminaires of four 40-watt lamps/luminaire. Determine the energy saving after replacing those with two 40-watt high-efficiency lamps/luminaire. This building is operated 8 hours/day, 5 days/week, 50 weeks/year. **(3 Marks)**
- j) Using a power factor triangle illustrate the consumption of a facility operating a motor that draws 200Kva and has a power factor (cos phi) of 70.7%. Determine how many kW and Kva does the motor draw from the main grid. **(2 Marks)**

QUESTION TWO

- a) Describe **SIX** tasks that can be performed in this step of building and utility data analysis giving an example of results expected from each task. **(6 Marks)**
- b) An office has length of 20m, width=10m, height=3m.
- 1) Ceiling to desk height is 2m.
 - 2) Area to be illuminated to a general is 250 lux using twin lamp 32 watt CFL Luminaire with a SHR of 1.25.
 - 3) Each lamp has an initial output of 85 lumens per watt.
 - 4) Maintenance factor is 0.63, Utilization factor is 0.69
- Design a lighting system for this office **(10 Marks)**
- c) For a detailed energy audit instruments are required for data collection process. Describe **FOUR** instruments energy auditor would require when auditing boilers of a steam power plant. **(4 Marks)**

QUESTION THREE

- a) Group relamping is more economical to replace all of the fluorescent and HID lamps in a facility at one time. Discuss Five advantages of this action in an organization that has established that lighting contributes a lot in it energy bills. **(10 Marks)**
- c) Consider the May bill for a company located in Kisumu town whose electric use is shown below: including the power factor clause which states A power factor clause states that the billing demand, upon which the demand charge is based, shall be the actual demand for the month corrected for the power factor by multiplying the measured actual demand by 80 and dividing the product by the actual average power factor expressed in percent. The power factor clause applies whenever the average monthly power factor is less than 80 percent.

Month: April 2006

Actual demand: 250 kW

Consumption: 54,000 kWh

Previous high billed demand: 500 kW (March 2006)

Power factor: 75%

Sales tax: 6%

Fuel adjustment:	0.0115/\$kWh
Cost of charge per unit:	\$.03528/kWh
Customer charge:	\$151.00

Determine the following:

- i. Power factor corrected demand. **(2 Mark)**
- ii. Minimum demand charge. **(1 Mark)**
- iii. Final billed demand. **(1 Mark)**
- iv. Demand charge. **(2 Mark)**
- v. Fuel adjustment. **(1 Mark)**
- vi. Total electricity charge for the month of April. **(3 Marks)**

QUESTION FOUR

- a) The management of a cement company based in Kisumu has contracted you as their internal energy auditor discuss **FOUR** types of energy audit that you would recommend to the management. **(8 Marks)**
- b) Describe **FOUR** properties that should be considered when formulating an electricity tariff for domestic consumers relying on decentralized supply. **(6 Marks)**
- c) Describe **THREE** recommendations ECMs an energy manager would suggest to improve the thermal performance of building envelope. **(6 Marks)**

QUESTION FIVE

- a) As an energy auditor discuss some of measures that can be considered to improve the energy performance of both primary and secondary HVAC systems. **(10 Marks)**
- b) Discuss **FIVE** light control systems can be adopted at design stage to allow incorporation of energy conservations opportunities in a new building. **(10 Marks)**