



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 8 Examination in Engineering: December 2025/January 2026

Module Number: ME 8211

Module Name: Energy Management

[Three Hours]

[Answer all questions, each question carries 10 marks]

Note: Clearly state any assumptions you made in answering the questions.

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- Q1. (a) Define an **energy audit**. Explain its purpose and discuss why an energy audit should be conducted **only after establishing an energy management system** in an organization. [3.0 Marks]
- (b) Describe the **three levels of energy audits**. For each level, clearly state:
- the scope of the audit,
 - the type of analysis involved, and
 - the expected outcomes or deliverables.
- [4.0. Marks]
- (c) Who is an **energy auditor**? Discuss the **knowledge, skills, experience, and accreditation requirements** of a competent energy auditor. Clearly distinguish between the roles of an **energy manager** and an **energy auditor**. [3.0 Marks]
- Q2. A detailed energy audit is a systematic approach used to identify energy conservation opportunities and improve energy efficiency in industrial and commercial facilities.
- (a) Explain the **Ten-Step Method of a Detailed Energy Audit**, clearly describing the **purpose and expected outcomes** of each step. [5.0 Marks]
- (b) Discuss the importance of **primary data collection, monitoring, and detailed trials** (Steps 4 and 5) in ensuring the accuracy of an energy audit. Provide **two practical examples** of measurements or experiments carried out during these steps. [3.0 Marks]
- (c) Why are **cost-benefit analysis and management reporting** (Steps 8 and 9) critical for the successful implementation of energy conservation measures? [2.0 Marks]

- Q3. An Energy Manager plays a critical role in improving organizational profitability through systematic energy management, which involves both technical and managerial responsibilities.
- (a) Explain the **overall objective of an Energy Manager** and discuss the **main techniques available for optimizing energy usage** in an organization. [3.0 Marks]
 - (b) With reference to an industrial organization, describe how an **Energy Management Programme** should be organized. Your answer should include:
 - (i) Key elements of the programme
 - (ii) Importance of top management commitment
 - (iii) Role of the Energy Management Committee
 [3.0 Marks]
 - (c) Discuss the **primary functions of an Energy Manager** under the headings: **Planning, Leading, Monitoring, Reporting, and Controlling**. Highlight why energy management is considered more of a **people-related challenge** than a purely technical one. [4.0 Marks]
- Q4. A centrifugal pump is used to transfer water from a ground-level storage tank to an overhead tank in an industrial facility. The pumping system consists of suction and delivery pipelines, control valves, and an electric motor as the prime mover.
- (a) Explain the **components of a pumping system** and clearly describe the roles of
 - (i) static head and
 - (ii) friction head in determining the total system head.
 [3.0 Marks]
 - (b) The pump is currently controlled by a throttling valve to meet varying flow demand. Suggest **three energy efficiency improvement measures** applicable to this system and briefly justify how each method reduces energy consumption. [3.0 Marks]
 - (c) A centrifugal pump delivers water at a flow rate of **0.05 m³/s** against a total head of **30 m**. The pump efficiency is **70%**.
 - (i) Calculate the **hydraulic power** developed by the pump.
 - (ii) Determine the **pump shaft power required**.
 [4.0 Marks]
- Q5. An office building is currently illuminated using **incandescent lamps**, each rated at **60 W**. The management plans to replace these lamps with **LED lamps** rated at **12 W**, providing the same illumination level. The office has **120 lamps**, and each lamp operates for an average of **10 hours per day, 250 days per year**. The cost of electricity is **LKR 45 per kWh**.

Question Q5 is continued on Page 3

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- (a) Calculate the **annual electrical energy consumption** of the existing incandescent lighting system. [2.0 Marks]
- (b) Calculate the **annual electrical energy consumption** of the proposed LED lighting system. [2.0 Marks]
- (c) Determine the **annual energy savings (kWh)** and **annual cost savings (LKR)** achieved by replacing incandescent lamps with LED lamps. [3.0 Marks]
- (d) If the purchase and installation cost of one LED lamp is **LKR 3,000**, calculate the **simple payback period** for the lighting retrofit project. [3.0 Marks]