



MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

P.O. Box 972-60200 – Meru-Kenya.

Tel: +254(0) 799 529 958, +254(0) 799 529 959, +254 (0)712 524 293

Website: www.must.ac.ke Email: info@mucst.ac.ke

UNIVERSITY EXAMINATIONS 2024/2025

SECOND YEAR, FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR
OF TECHNOLOGY IN ELECTRICAL AND ELECTRONICS ENGINEERING

EET 3206: ENERGY RESOURCES

DATE: JANUARY 2025

TIME: 2 HOURS

INSTRUCTIONS: Answer Question ONE and any other TWO questions.

: Start each question on a fresh page

: Do not answer more than THREE questions

QUESTION ONE (30 MARKS)

- a) Explain the three primary types of fossil fuels. (5 Marks)
- b) Describe the environmental impacts of burning coal. (3 Marks)
- c) Discuss the role of policy and regulation in promoting renewable energy development. (6 Marks)
- d) A coal-fired power plant burns 500 tons of coal per hour. The energy content of coal is 24 MJ/kg, and the plant's efficiency is 35%. Calculate how much electrical energy is produced by the plant per hour. (4 Marks)
- e) A factory has a load with an apparent power of 100 kVA and a power factor of 0.7. The management decides to correct the power factor to 0.9. Calculate the reactive power reduction and the new reactive power. (4 Marks)



MUST is ISO 9001:2015 and



ISO/IEC 27001:2013 CERTIFIED

- f) A factory operates with a load of 200 kW and a power factor of 0.7. Calculate the capacitive kVAR required to improve the power factor to 0.9. (4 Marks)
- g) Discuss the role of renewable energy sources in mitigating climate change. (4 Marks)

QUESTION TWO (15 MARKS)

- a) Explain why natural gas considered a cleaner fossil fuel compared to coal and oil. (3 Marks)
- b) Discuss the impact of tidal and wave energy systems on marine ecosystems. (7 Marks)
- c) A wind turbine with a rotor diameter of 100 meters is operating in a location with a wind speed of 12 m/s. The air density is 1.225 kg/m^3 , and the turbine has an efficiency (power coefficient) of 45%. Calculate the power output of the turbine. (5 Marks)

QUESTION THREE (15 MARKS)

- a) Examine the safety concerns and waste management challenges associated with nuclear power. (6 Marks)
- b) A solar panel has an area of 20 m^2 and an efficiency of 18%. The average solar irradiance at the location is 1000 W/m^2 . Calculate the amount of energy produced by the solar panel in 5 hours of full sunlight. (3 Marks)
- c) Discuss the significance of energy conservation and energy audits in industrial sectors. (6 Marks)

QUESTION FOUR (15 MARKS)

- a) Analyze the socio-economic effects of large-scale hydropower projects. (6 Marks)
- b) A tidal barrage has a potential energy storage of $2,000,000 \text{ m}^3$ of water at a height of 10 meters. The density of water is 1000 kg/m^3 , and the efficiency of the turbines is 80%. Calculate the electrical energy generated in one tidal cycle. (4 Marks)
- c) A short transmission line has a per-unit impedance of 0.1 p.u. If the sending end voltage is 1.05 p.u. and the load at the receiving end is 1.0 p.u. with a power factor of 0.9 lagging, calculate the voltage drop across the transmission line. (5 Marks)



QUESTION FIVE (15 MARKS)

- a) Compare and contrast solar and wind energy as renewable energy sources. (6 Marks)
- b) A company replaces 100 incandescent bulbs (60 W each) with LED bulbs (10 W each). If the bulbs are used for 8 hours per day, calculate the energy savings per day and per year.
(4 Marks)
- c) A three-phase transmission line has an inductance per phase of 1.2 mH per kilometer. Calculate the total inductance for a 200 km length of this transmission line. (5 Marks)