



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 2ND SEMESTER 2023/2024 ACADEMIC YEAR

CENTRE: MAIN CAMPUS

COURSE CODE: TEB 1406

COURSE TITLE: ENERGY ECONOMICS

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

DATE: /04/2024 EXAM SESSION:

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.**
- 4. Use Clear and Well Labelled Diagrams/ illustrations where necessary**
- 5. EACH QUESTION SHOULD BE STARTED ON A NEW PAGE**

QUESTION ONE (30 Marks) (Compulsory)

- a) Production of electricity is by a number of technologies of different alternative fuels. Name and explain (with an example) the two basic group categories of the options (6 Marks)
- b) Therefore, for smooth electricity system operation, three types of plants (or technologies) are required: Briefly distinguish their characteristics appropriately options (6 Marks)
- c) Define the following as they are being used in electricity supply options: Diversity factor, Coincidence factor, Daily load curve, load duration curve, base load, intermediate load, peak load, Capacity factor and system load factor (18 Marks)

QUESTION TWO (20 Marks)

- a) One of the various analytical methods used in analyzing energy demand is the simple descriptive analysis. The three simple commonly used indicators for describing change in demand or its relationship with an economic variable are growth rates, demand elasticities and energy intensities.
 - 1) Define the terms growth rates, Demand elasticities and energy intensities (6 Marks)
 - 2) Given that: a = Annual Growth in Demand, E_T = Energy Demand in year T and E_{T+1} represents Energy Consumption in year $T+1$; Also given that: E_{T1} = Energy demand in period $T1$; E_{T0} = Energy demand in period $T0$ and a_g = Annual growth rate. A): Hence generate/formulate the relevant equations for:
 - i) Annual growth rate (2 Marks)
 - ii) Year on year growth rate (2 Marks)
 - iii) Annual growth rate over a period (2.5 Marks)
 - b) Then calculate the values of i), ii) and iii) from the information as: According to BP Statistical Review of World Energy, the world primary energy consumption was 9,262.6 Mtoe in 2000. The demand increased to 11,104.4 Mtoe in 2007 and 11,294.9 Mtoe in 2008. Calculate the growth rate of demand between 2007 and 2008. Also calculate the annual average growth rate between 2000 and 2008. (7.5 Marks).

QUESTION THREE (20 Marks)

An economic analysis of an Energy project analyzes the welfare impacts of a project and it essentially involves three elements:

- a) State the three elements in the analysis (6 Marks)
- b) The Differentiate between financial analysis and economic analysis (4 Marks)
- c) Indicators of Cost-Benefit Comparison are those that ignore time value of money or those that employ time value of money. List the indicators with respect to their categories: (5 Marks)
- d) State the equations to the respective listed indicators in c) (5 Marks)

QUESTION FOUR (20 Marks)

- a) Explain the term Levelized Cost of Energy (LCOE) as an analysis method. (3 Marks)
- b) An electric power plant that produces 4 billion kWh_e per year has a capital cost of Ksh1000 million and anticipated lifetime of 40 years. The salvage value is estimated to cover the cost of dismantling the plant. The capital cost of the plant is repaid at 14% interest, compounded annually. The total annual operational cost of the plant is Ksh 50 million and the annual return to investors is estimated at 20% of the operating cost plus the capital repayment cost - Determine the levelized cost of electricity for this plant, in Ksh/kWh_e. NB if the operating (11 Marks)
- c) State the four steps of the levelization process and the two necessary basic equations. (6 Marks)

QUESTION FIVE (20 Marks)

- a) List and explain the main characteristics of commercial energy projects (12 Marks)
- b) The demand for an electric system at any time is the total of all consumer demand with consumers different appliances (total of which may be occurring simultaneously) - Determine the following:
 - i) If there are 100 consumers of 1 kW load and are using electricity simultaneously: what would be the maximum demand in such a situation (2 Marks)
 - ii) Since the loads coincide, the demand is not diversified; determine the diversity factor. (2 Marks)
 - iii) If the consumers made to use electricity sequentially What is the peak demand (2 Marks)
 - iv) What is the sum of individual maximum load - (is 10 kW. In this case, the load is highly diversified determine the diversity factor. (2 Marks)