KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2020/2021 ACADEMIC YEAR

FOURTH YEAR FIRST SEMESTER
MAIN EXAMINATIONS

FOR THE DEGREE OF RENEWABLE ENERGY

COURSE CODE: IET 412

COURSE TITLE: ENERGY STORAGE TECHNOLOGY

DATE: 16/07/2021 **TIME: 9:00-11:00AM**

INSTRUCTIONS TO CANDIDATES

TIME: 2 Hours

Answer question ONE and any TWO of the remaining

KIBU observes ZERO tolerance to examination cheating

Section A-Compulsory (30 marks)

Question One

(a) RE offers access to affordable, clean, and reliable energy services for sustainable development. The intermittent nature of most RE-based electricity (e.g., wind, solar) must be managed appropriately to ensure continuous availability and stability of the power network. Briefly explain any 2 methods of management strategies for RE to address the intermittency and variability challenge (5mks)

(b) Define the term energy storage (2mks)

(c) (i) As a renewable energy, give FOUR points to just justify the need for energy storage in Kenya? (4mks)

(ii) Discuss any THREE types of electric grids in terms of voltage as used in electricity transmission and distribution. (3mks)

(d) Give FOUR reasons supporting why energy storage is important in energy economy (4mks)

(e) As an energy storage expert, explain how energy storage capacity of a fly wheel can be increased (3mks)

(f) Explain the main difference between sensible & latent thermal energy storage. (4mks)

(g) What are the advantages of using hydrogen as a source of energy in an economy (5mks)

Section B –Answer any Two Questions (40marks)

Question TWO

Pumped hydro energy storage methods. **(15mks)**

Flywheel energy storage **(5mks)**

Question Three

Using a well labelled schematic diagram, describe Compressed Air Energy Storage (CAES) method. (20 mks).

Question Four

[6 marks].

A householder sticks a shiny silver coated sheet of plastic bubble wrap on the wall behind the radiator in the lounge in order to save energy. Explain how this can reduce heat loss from the lounge by conduction, convection and radiation.

(4mks.)

Differentiate between Energy transmission and energy distribution as used in electricity

(4mks).

Hydrogen technology can be the solution to the current energy crisis in transport sector. Give explanations in support or opposing this statement.

(3 mks).

Support or oppose the following statement "Energy conservation is our best and cheapest source of energy we have."

Question Five

Some well-known examples of battery types used as stationary storage system for RE systems are listed in the Table

Sandia National Laboratories cost and performance assumptions

Technology (battery type)	Power subsystem cost $/kW	Energy storage subsystem cost $/kW	Charge-discharge efficiency %	Cycles
Advanced lead-acid	400	330	80	2,000
Sodium/sulfur	350	350	75	3,000
Lead-acid with carbon enhanced electrodes	400	330	75	20,000
Zinc/bromine	400	400	70	3,000
Vanadium redox	400	600	65	5,000
Li-ion (large)	400	600	85	4,000

(a) Explain what the following values mean with reference to the table:

(i) Cycles [2 Marks]

(ii) Charge-discharge efficiency [3 Marks]

(b) Lead-acid batteries are facing stiff competition from other battery technologies for applications in renewable energy storage systems

(i) With reference to specific applications explain why batteries based on Lithium are gaining preference over lead-based

(ii) Explain any Three limitations of Lithium based batteries [15 Marks]