



KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

FOURTH YEAR SECOND SEMESTER
MAIN EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN RENEWABLE ENERGY AND BIO
FUELS TECHNOLOGY

COURSE CODE: REN 425

COURSE TITLE: HYBRID ENERGY SYSTEMS

DURATION: 2 HOURS

DATE: 05/09/2022

TIME: 2:00PM-4:00PM

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other **TWO (2)** Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of **3** printed pages. Please Turn Over



KIBU observes **ZERO** tolerance to examination cheating

Question One

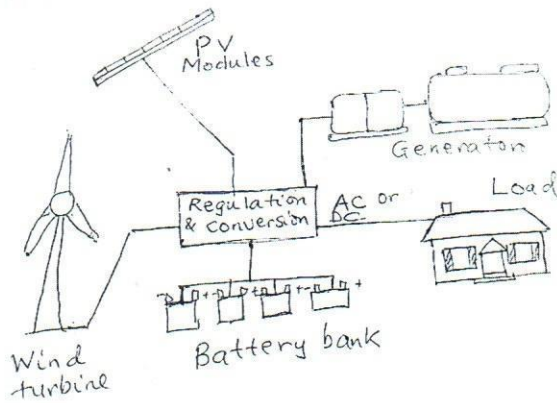
- (a) The main goal of Hybrid Energy System is, to improve electrical power production, to minimize cost, to reduce negative effects associated with burning fossil fuels and to improve the overall system efficiency. Explain. [6 marks]
- (b) Wind-diesel systems can involve continuous operation of the diesel engine; what are the advantages and disadvantages of this approach? [6 marks]
- (c) What's the motivation for including energy storage in a wind-diesel system? What's the ideal duration of the energy store and why? What technologies are best suited to this? [6 marks]
- (d) Define the following terms as applied to hybrid energy systems
- (i) optimization, [2 marks]
 - (ii) reliability, [2 marks]
 - (iii) grid, [2 marks]
 - (iv) micro grid, [2 marks]
 - (vi) macro grid, [2 marks]
 - (vii) diverse generation, [2 marks]

Question Two

National electricity grids are almost always hybrid. Explain in detail, with reference to the electricity grid of Kenya [20 marks]

Question Three

- (a) Currently, Kibabii University operates a hybrid electrical energy system
- (i) Explain the aim of the hybrid energy system as currently constituted at Kibabii University? [3 marks]
 - (ii) State the energy components of the hybrid energy system at Kibabii University [2 marks]
 - (iii) Explain the economical value of the system (if any) as currently constituted [3 marks]
- (b) The University intends to add Solar PV to the current electrical energy supply, while retaining the grid
- (i) Explain the benefit of adding solar PV [3 marks]
- (c) The figure below illustrates a hybrid energy system. Explain how it operates [9 marks]



Question Four

- Explain what is meant by a “hybrid energy system” [3 marks]
- Briefly explain the various ways of classifying hybrid energy systems [4 marks]
- Briefly describe how the software *HOMER (Hybrid Optimization Model for Electric Renewables)* is used in the design of hybrid energy systems [13 marks]

Question Five

- Describe a suitable hybrid energy system in a remote location with a seasonal stream, wind resource and solar PV [3 marks]
- Just like a national grid with many generators online, control of a hybrid energy system is very important. Explain [4 marks]
- Study the control flow diagram for a hybrid energy system shown and explain the algorithm [13 marks]

