



TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
UNIVERSITY EXAMINATION FOR:
BSc. / B. Eng. Mechanical Engineering
EMG 2507 : NEW & RENEWABLE ENERGY RESOURCES
SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: SEPTEMBER 2018
TIME: 2 HOURS
DATE: Pick Date Sep 2018

Instruction to Candidates:

You should have the following for this examination

- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions. Attempt any **THREE** questions.

Maximum marks for each part of a question are as shown.

Do not write on the question paper.

Question ONE

- Explain **THREE** methods of classifying wind turbines (5 marks)
- The Electric Pitch control system has been developed alternatively with the hydraulic pitch control system. Using a well labeled diagram, explain the parts of an electric pitch control system and give two advantages of the electric pitch control system over the hydraulic pitch control system (4marks)
- Explain **SIX** important terminologies that are indicated on a solar panel name plate (3marks)
- Give **FOUR** advantages of using a charge controller in solar PV systems (2marks)
- Explain the following electrical terminologies associated with hydropower generation
 - Installed capacity
 - Utilization factor
 - Load factor
 - Primary power (6 marks)

Question TWO

- a) Using a wind power curve, explain the following terminologies as used in wind power generation
 - i. Cut in speed
 - ii. Cut out speed
 - iii. Rated speed (5marks)
- b) Explain **SIX** challenges in wind power generation (3marks)
- c) Solar systems require the use of deep cycle batteries. Explain **THREE** types of batteries within this category and suggest methods to avoid higher self discharge rates (6marks)
- d) Define the term fuel cell. With the aid of a well labeled diagram, explain the working principle of a fuel cell in the generation of electricity (6marks)

Question THREE

- a) Given the following information for a solar home stand alone system

load	Quantity	watts	Hrs/day
29 inch color TV	1	120	5
Multichoice decoder	1	15	5
LED bulb	4	9W	6
Radio	1	20	6

Determine

- i. the load
 - ii. the PV array size
 - iii. the size of the battery bank
 - iv. size the charge controller
 - v. the size of inverter to be used (10marks)
- b)** Briefly explain the process of manufacturing the following biofuels
- i. syngas
 - ii. biodiesel
 - iii.** ethanol (6marks)

c) Most modern large wind turbines are horizontal- axis turbines with typically three blades. Using a well diagram, explain the wind turbine configuration (4marks)

Question FOUR

a) Explain the following methods of generating biopower

- i. Biomass gasifiers
- ii. Direct fired systems
- iii. Pyrolysis (6 marks)

b) Using a sketch differentiate between single stage hydro power development scheme and cascade hydro system (4marks)

c) The use of wind energy can be traced back thousands of years to many ancient civilizations. The ancient human histories have revealed that wind energy was discovered and used independently at several sites of the earth. Giving examples, discuss the history of wind energy applications (3marks)

d) Prove that the formula for theoretical wind power is given by

$$P = 0.5A\rho V^3$$

Hence explain how the power coefficient C_p affects the value of the theoretical power (4 marks)

e) Explain THREE primary functions of a battery in a solar PV system (3marks)

Question FIVE

a) Name **FOUR** types of wind energy hybrid systems (4marks)

b) Differentiate between a base load power plant and a peak load power plant giving **TWO** examples of each (4marks)

c) Using a sketch explain the principles of hydropower generation using a medium head power plant and list **FOUR** factors to be considered during the feasibility studies of this power station (6marks)

d) Explain the following types of wave energy technologies

- i. Oscillating water column
- ii. Oscillating bodies (6marks)