



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF MECHANICAL & AUTOMOTIVE
ENGINEERING

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMG 2507 : NEW & RENEWABLE ENERGY SOURCES

END OF SEMESTER EXAMINATION

SERIES: APRIL 2016

TIME: 2 HOURS

DATE: May 2016

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

Question ONE (COMPULSORY) (30 Marks)

a)

i) Explain the different types of hydropower plants. **[6 marks]**

ii) Explain the energy conversions that occur in a hydropower plant. **[4 marks]**

b) Explain the production of electricity in a binary cycle geothermal power plant. **[4 marks]**

c) Explain the TWO solar photovoltaic technologies giving TWO examples in each case. **[6 marks]**

d) Explain the importance of wind resource assessment. **[3 marks]**

e) State the functions of each of the following parts of a wind turbine

- i. Rotor
- ii. Gearbox
- iii. Yaw controller

[3 marks]

f) Explain FOUR biomass feedstock conversion technologies that convert biomass into power, heat and fuels other than combustion and oil extraction

[4 marks]

Question Two (20 Marks)

a) Define the following with respect to wind turbines:

- i) Cut-in wind speed
- ii) Rated wind speed
- iii) Cut-out wind speed

[3 marks]

b) i) State any **THREE** disadvantages of horizontal axis wind turbines.

[3 marks]

ii) Derive the equation for the theoretical power generated by a wind turbine.

[5 marks]

c) Calculate the rate of energy absorption per unit area of a collector given that the solar irradiance is 1000W/m^2 and effective transmittance-absorption product is 0.8.

[3 marks]

d) Use a diagram to illustrate the passive solar water heating system.

[6 marks]

Question Three (20 Marks)

a) Explain the classification of hydraulic turbines based on:

- i) Flow path
- ii) Pressure change

[6 marks]

b) An impulse turbine develops 4500 kW at a head of 200 m. The turbine runner has a speed of 200 rpm discharges 0.8 m³/s. If the head on the same turbine falls during dry season to 184.3 m, determine the new discharge, power and the speed of the turbine.

[6 marks]

c) With the aid of a diagram explain the working of a dry steam geothermal plant.

[8 marks]

Question Four (20 Marks)

- a) Differentiate between the pitch controlled wind turbines and the stall controlled wind turbines. **[6 marks]**
- b) Name and state the function of the components of hydroelectric power plant. **[4 marks]**
- c) Calculate the power for a hydraulic turbine that is 80% efficient, with water at 1000kg/m^3 and a flow rate of $90\text{m}^3/\text{second}$ and with a net head of 150m. (*Take acceleration due to gravity to be 9.8m/s^2*). **[3 marks]**
- d)
- i) List THREE solar receiver technologies. **[3 marks]**
- ii) Explain the Dish stirling concentrating thermal collector **[4 marks]**

Question Five (20 Marks)

a) Define tidal energy and explain how it is harnessed with the aid of schematic diagram.

[8 marks]

b) Explain the following wave power designs

- i) Oscillating water column
- ii) Wave surge or focusing devices

[6 marks]

c)

i) Explain biogas production

[2 marks]

ii) Illustrate using a diagram a biogas plant

[4 marks]