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 90m^3/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**]