TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED SCIENCES
MATHEMATICS AND PHYSICS DEPARTMENT
UNIVERSITY EXAMINATION FOR BACHELOR OF TECHNOLOGY DEGREE IN

RENEWABLE ENERGY (BTRE)

APS 4332: BIOFUELS AND WIND ENERGY

END OF SEMESTER EXAMINATION

SERIES: May Series 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** and any other **TWO** questions.
Do not write on the question paper.

QUESTION ONE (30 MRKS)
(a) (i) Define the term biomass. (1mrks)
  (ii) List any three types of traditional biomass. (3mrks)
  (iii) Explain the concept of 'Carbon neutral' environment. (3mrks)
  (iv) Differentiate between Green diesel and Syngas. (2mrks)
b) (i) Why is biogas technology considered to be an appropriate technology for the next energy
    generation? (4mrks)
  (ii) Mention four benefits of a biogas plant. (4mrks)
  (iii) Explain how is biogas produced in a biogas digester. (2mrks)
  (iv) Explain between the following biogas digestions processes that occur in the digester.(3mrks)
        1. Psychrophilic digestion
        2. Mesophilic digestion
        3. Thermophilic digestion
c) (i) Calculate the velocity of wind whose density is 2000g per unit cubic metre moving in an
    open field towards a weather station if it carries a kinetic energy of 1.17×10^3 kj. (3mrks)
  (ii) Determine its specific power at this site. (2mrks)
  (iii) Give any two major parts of a wind turbine. (2mrks)

QUESTION TWO (20 MRKS)

2 (a) Give the function of the following units in a wind turbine. (5mrks)
- (i) Nacele
- (ii) Electrical generator
- (iii) Yaw mechanism
- (iv) Blade
- (v) Sensors and control

b) (i) Define the term specific power of wind energy. (2mrks)

(ii) Calculate the kinetic energy of wind with a density of 2340g per unit cubic metre moving with speed 60 km towards east. (3mrks)

(iii) Determine its specific power of this wind at this site. (3mrks)

(iv) If the wind velocity becomes discontinuous from 60km/hr to 70km/hr at the "plane" of the rotor blades used to harvest their energy, calculate the mass flow if the area of the plates are given as $06M^2$. (3mrks)

(v) Calculate the annual energy potential if the annual average wind speed here is 60km/hr. (4mks)

QUESTION THREE (20 MRKS)

(a) Differentiate between the following; (3mks)

(i) Direct and Indirect methods of converting biomass to energy.

(ii) Differentiate between electrochemical and a biochemical conversions of biomass.

(iii) Define the term Pyrolysis as used in biomass.

b) (i) What does the term "First generation biofuel' refer to? (1mrk)

(ii) List any three First generation biofuels. (3mrks)

(iii) Describe briefly any two biofules you have given above. (4mrks)

(iv) Describe the following types of biofules;
- a) Biogas. (2mrks)
- b) Green diesel. (2mrks)

c) (i) What are Second generation biofuels? (1mrk)

(ii) Differentiate between first generation biofules and second generation biofuels. (1mrk)

(iii) Describe how anaerobic digestion process that produces biogas. (3mrks)

QUESTION FOUR (20 MRKS)

a) (i) What does the term 'scaling a biogas' refer to? (2mrks)

(ii) Define the following terms as used in scaling of a biogas plant operation. (3mrks)
- a. Dry matter
- b. Organic dry matter
- c. Digester loading

(iii) Given that a certain digester has a digester volume (V_D) of 4800 litres. Determine its retention time (RT) if its daily supply (S_d) period of 60 days. (3mrks)

(iv) A certain Biogas plant in Kilifi has the following data: Digester volume (V_D): 4.8 m³; Retention time (RT): 80 days; Daily amount of fermentation slurry (S_d): 60 kg and the proportion of organic matter: 5 %. Calculate its digester loading. (3mrks)

(v) Give one negative environmental impact of biofuels. (1mrks)

b) (i) Define the term Spatial Mapping and Modeling as used in wind energy. (2mrks)

(ii) Moving wind has kinetic that be harnessed. Calculate the kinetic energy wind of density 2340g per unit metre moving with speed 60 km towards east. (2mrks)

(iii) Determine the specific power of the wind in b (ii) above at this site. (2mrks)

(iv) What is a wind turbine? (2mrks)

QUESTION FIVE (20 MRKS)

(a) What are the following terms as used in the wind power industry: (6mrks)
  a. High-speed shaft
  b. Brake
  c. Gearbox
  d. Generator
  e. Nacelle

b) Speed control used to control wind power turbine fall into the following categories given below. Describe each method given. (8mrks)
  (i) No speed control
  (ii) Yaw and tilt control
  (iii) Pitch control
  (iv) Stall control

c) What are the functions of the following parts of a wind energy harvesting device? (3mrks)
  i). Pitch
  ii) Upwind and downwind
  iii) Vane

  d) State one advantage and two disadvantages of wind energy. (3mrks)

END