TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology in Conjunction with Kenya Institute of Highways and Building & Technology (KIHBT)

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

HIGHER DIPLOMA IN TECHNOLOGY

EEP 3206: RENEWABLE ENERGY

END OF SEMESTER EXAMINATION
SERIES: MAY 2015
TIME ALLOWED: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer Booklet*

This paper consists of **FIVE** questions. Answer question **ONE (Compulsory)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **FOUR** printed pages

Question One (Compulsory)

a) Describe the following solar radiation components:
   (i) Direct radiation
   (ii) Diffuse radiation
   (iii) Albedo radiation
   (iv) Controlled (focused) radiation **(4 marks)**

b) State any SIX demerits of solar energy as compared to mains electricity **(6 marks)**

c) The solar radiation collected at a certain site is 4.05kWh/m^2/day. The design load Sd = 768VA and the design energy demand Ed = 3,216Vah 120V, Batteries and 120w peak module power panels are to be used. The following deviating and other factors are provided.

I PV module

$\delta temp = 0.85$

$\delta man = 0.95$

$\delta dirt = 0.97$

II Energy Demand

Contingency for future growth (kg) = 10%

Design margin = 10%

Oversupply coefficient = 1.1
Coulombs efficiency of battery and sub system = 90%

Battery

II Ageing factor = 1.25
Capacity factor 1 .1
Temperature factor = 0.96
Depth of discharge = 80%

Estimate:

(i) The correct design and energy demand
(ii) The minimum battery capacity
(iii) The number of PV modules required

Question Two

a) Explain why:
   (i) Hydropower is not suitable for Baseload
   (ii) Dummy load is used for offgrid hydrosystems
   (iii) Moving water has higher energy than still water
   (iv) Tiday power has formal hydropower is not yet widdy used **(4 marks)**

b) With the aid of a labeled diagram describe the functions of at least SIX parts of a conventional hydropower generating station **(6 marks)**

c) A dam has an outlet vertical pipe linking to a hydro-generator. The total length of the pipe is 50m while its diameter is 1.5m. The speed of water just before action on the turbine is 3m/s. The electrical and mechanical efficiencies of the system is 0.9 and 0.75. Use g = 9.81m/s^2 and $\delta = 1000kg/m^2$ to calculate.

(i) The total kinetic and potential energy of water
(ii) The output power of the hydrognerate
(iii) The maximum demand of the load factor is 30%

Question Three

a) State any:

(i) TWO advantages of variable speed turbines
(ii) TWO disadvantages of permanent magnet type wind generators **(4 marks)**

a) Explain SIX reasons why wind power development has superseded solar power development in recent years **(6 marks)**

b) Figure Q3 below shows a diagram of a wind turbine and generator

Air density = 1.2kg/m^3
Electrical efficiency = 75%

The diameter of rotor swept area is 5m with effective force acting at a point as shown. If the output of the 8 po generator is 9.0KW, determine:

(i) The coefficient wind speed on that side
(ii) The existing wind speed on that side
(iii) The rate of change of electrical wind power of existing wind speed keeping the turbine control constant **(10 marks)**

Question Four

a) State any FOUR merits of geothermal power over Hydropower **(4 marks)**

b) With the aid of suitable sketches describe:

(i) How geothermal power is harnessed
(ii) The layout of a geothermal power generating station connected to Grid **(6 marks)**

c) A Geothermal power station has hot rocks having calorific value of 10000kcal/kg and equivalent mass

of 50 tonnes. The well, Mechanical and Electrical Efficiencies are 33, 78 and 90% respectively. Apply 1KN = 8600Kcal to find:

(i) The amount of Geothermal power generated
(ii) The savings made in ksh if 30 such power stations are installed to displace one equivalent load fired station utilizing coal worth ksh 250,000 per ton **(10 marks)**

Question Five

a) State any FOUR sources of Biomass matter for power generation

b) With the aid of labeled sketches, describe proccess in:
(i) Biomass steam power generation
(ii) Biodiesel power generation

c) Certain assorted Biomass matter has calorific value of 10,000KcAL/kg. If is required to be used for electric power generation through Mechanical and Electrical parts having 0.6 and 0.85 efficiencies respectively. A domestic load of 10KN is required to be supplied by the system. (1kwhr = 860kCal)

(i) Calculate the weight of Biomass required for one month
(ii) 100 such domestic units collaborate to make one large system in order to improve total efficiency by 25%, calculate the weight of biomass required for the month of big system
(iii) Calculate the savings made with the large system given that biomass matter is supplied at ksh 300/kg