FNU FIJI NATIONAL UNIVERSITY

School of Electrical and Electronic Engineering
Semester 1, 2012

Trade Diploma in Electrical Engineering
(Electrical & Renewable Energy)

EEE438 – Renewable Energy Technologies

Date: 06/06/2012   **Time: 1.00 – 3.10 pm**

Room: As per Timetabled

Instructions to Students

1. You are allowed an extra ten (10) minutes of reading time during which you are <u>NOT</u> allowed to write.

2. Write your answers in the answer booklet provided

3. Write your Student ID number at the top of each attached sheet

4. You may use calculators provided they are non-programmable.

5. Clearly number the questions in your answer paper in their correct sequence and write legibly. Show all working.

6. Attach any extra sheets used to your answer booklet securely with the string provided

7. There are four (4) Sections' in this paper. **Answer all Section.**

SECTION A [25 Marks]

1. Write a short essay of <u>maximum length not exceeding 300 words</u>, discussing about renewable energy technologies as a whole.
You must take any <u>three major renewable energy resources,</u> and discuss the following,
   i) Present and future generation of these renewable energy
   ii) Ways to utilize and/or extract energy from these resources and
   iii) The social, environmental and economic implications of each resources
   [18 marks]

2. Explain Primary energy, end-use energy and embodied energy [3 marks]

3. Differentiate between cut in wind speed and rated wind speed of the wind turbine. [4 marks]

SECTION B [26 Marks]

1. Sketch a schematic/block diagram of a standalone PV system connected to an AC and DC loads. Describe the functions of each components of the system [7 marks]

2. What is the difference between a bypass and a blocking diode? Why is it important to be used in a PV system [3 marks]

3. Describe three ways in which a PV system is most commonly used [3 marks]

4. Explain the following components in a wind turbine: Blades, Rotor, gear Box, Generator, Yaw drive [5 marks]

5. What are three factors that must be considered when designing a battery bank, give a reason for each of your answer [5 marks]

6. Explain the following terms:
   i) Current Carrying Capacity
   ii) Boosting charge
   iii) equalizing charges [3 marks]

SECTION C [24 Marks]

1. Calculate the length of the day at latitude 15° on 21st of July in Suva[3 marks]

2. List four properties of a good biodiesel fuel [2 marks]

3. Explain the following components in a small hydro power station: weir, penstock and Leat [3 marks]

4. Explain what is the difference between Brayton and Rankin cycle [2 marks]

5.
  i) Describe the principle of operation of a reaction and impulse turbine
  [2 marks]
  ii) Name the turbine you would use in a case of a large slowly flowing river, which has a high flow rate but low head. Give a reason for your answer
  [2 marks]

6. A village requires 5kW of electrical power to cater for their needs. A river, which can provide a total head of 60m, is considered for a hydro-power source. If the efficiency of the turbine and the genset of the proposed power station is 90% and 80% respectively, calculate the following:
  i) The required power input at the jet? [4 marks]
  ii) What will be the velocity of the water at the jet if there is a head loss of 5m? [2 marks]
  iii) What will be the cross-sectional area of the jet if the flow rate at the jet is 1 liter per second? [2 marks]
  iv) What will be the power produced by the jest if there is 1 jet that is hitting the turbine blades? Will there be enough power produced to supply the village as a whole? [2 marks]

SECTION D   [25 Marks]

1. Estimate the annual energy production from a HAWT with a 20m diameter operating in a wind regime with an average wind speed of 6m/s. assume that the turbine has an efficiency of 0.4 and is operating under standard conditions [take density as 1.225 kg/m^3] [5 marks]

2. Using the information given below, size a standalone system including the battery size and panel size that will be required to deliver essential loads

Location: Sigatoka   Peak sun hour: 4.5
Days without sunlight: 5   Inverter efficiency: 90%
Maximum battery discharge level: 50%   Inverter input voltage: 48V
BP Solar Panel: 135 watts, 17.6V   Battery capacity: 100Ah, 12V
                                              [10 marks]

Load	AC/DC	Duty Cycle	Rating (A)	Quantity
Lights	230V AC	4	0.1	6
Lights	48V DC	2	0.1875	2
Television	230V AC	3	0.348	1
Computer	230V AC	2	0.8696	1
Fans	230V AC	2	0.3261	4

3. A valley lies between two parallel ranges 50km long and 5 km apart. The catchment area for the river is 70% of total area. A generator can be installed 100 m below the dam. If the region has an annual rainfall of 3 m and assuming that 40% of the rain is run off, only 50% of the river is used for power generation and a loss of 10% occurs in the penstock than calculate the power output of the system. [10 marks]

END OF EXAMINATION