



College of Engineering, Science and Technology

**School of Electrical and Electronics Engineering
Trimester 1, 2016**

**Trade Diploma in Electrical Engineering
(Electrical & Renewable Energy)**

EEE544 – Renewable Energy Technologies

Duration: 2 hours & 10 minutes

Date: TBA

Time: TBA

Room: As per Timetable

Total Marks: 100

Instructions to Students

1. You are allowed an extra ten (10) minutes of reading time during which you are NOT 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. **All Sections are compulsory.**

SECTION A

[25 Marks]

1. Illustrate and explain the following systems:

- i) Stand-alone PV system **[2 marks]**
- ii) Solar Water Pumping **[1 marks]**
- iii) Grid connected PV system **[2 marks]**

2. Find the length of the day on 14th November 2013 in:

- i) Suva (latitude 18.2° South) and in **[5 marks]**
- ii) Oslo (latitude 60° North)

3. What are the purposes of bypass and a blocking diode and mention on how should it be connected to a solar panel? **[3 marks]**

4. Discuss the social/economic/environmental impacts of Renewable Energy Technologies. **[4 marks]**

5. What is an Energy Audit? How do you carry out an Energy audit? Elaborate on the reasons of having high energy bills and how this issue could be encountered? **[4 marks]**

6. A portion of an electricity bill for a domestic dwelling in Fiji is given below and you are told that this customer is registered for government subsidy:

Tariff Description	Reading type	Meter Number	Reading		Usage	Billed Days
			Present	Previous		
Domestic	Normal Reading	15652:1	00005755	00005685	70	30

You are provided with the following information:

- Customers whose monthly usage is less than or equal to 95kWh will be charged 33.10 cents/kwh but will qualify for a Government subsidy of 15.90 cents

Customers whose monthly usage is more than 95kWh will not qualify for the Government subsidy and will therefore pay the full amount of 33.10 cents/unit. For the information provided above, calculate the bill for the domestic dwelling that has an opening balance of \$2.00 CR showing a step by step calculation and also taking VAT into account. **[4 marks]**

SECTION B

[25 Marks]

1. Using the information given below, size a standalone system including the battery size and panel size that will be required to deliver essential loads. Also sketch the connection diagram of battery bank and the panels. Also size the charge controller and battery. **[15 marks]**

Efficiency = 90% Peak Sun Hour = 3.5 h Battery DOD = 80%
 Location = Lautoka System Voltage = 12V Inverter Voltage = 12V
 Battery Capacity = 100Ah @ 12V Panel Rating = 17.2V, 8.72A
 No. of consecutive days without sunlight = 2

Voltage	Load	Power (W)	Duty Cycle (h)
AC	2 x Light	18	5
DC	2 x Light	7	6
AC	1 x Television	80	4
AC	2 x PowerPoint	200	2

Note: Power (W) = the rating of each individual item only and is not the total power

2. Explain the term “solar tracking” and how does the solar output compare with fixed panels? **[1 mark]**
3. Estimate the annual energy production from a HAWT with a 10m radius operating in a wind regime with an average wind speed of 6m/s. Assume that the turbine is operating under standard conditions and has a power coefficient of 0.4 and drive train efficiency of 60%. **[3 marks]**
4. Name the instruments that are used to measure the following quantities:
- i) Solar radiation
 - ii) Wind speed **[2 marks]**
5. Comment on the orientation and tilt angle for capturing maximum solar radiation for a fixed panel. **[2 marks]**
6. Draw the Power curve of a wind turbine labelling the cut-in, cut-out speed and rated speed. **[2 marks]**

SECTION C

[25 Marks]

1. Explain the two types of terrains. Comment on the effects of a man-made structure located very near to a wind turbine. **[2 marks]**
2. A catchment area of 40km long and 30km width is needed to build a hydro system. With a head height of 200m to dam the turbine can be installed to produce power from the dam. If the region has an annual rainfall of 6.0m and the turbine and generator efficiency is 90% and 95% respectively, calculate the power output of the system. *(Take any assumptions necessary for estimation)* **[7 marks]**
3. A hydro power scheme consists of a storage dam located 50m above the power station. If the head loss in the penstock is 5m,
 - i) What is the velocity of the jet? **[2 marks]**
 - ii) If the total power delivered by the jets to the 2-jet Pelton Wheel turbine is 300kW, what is the radius of each jet? **[5 marks]**
4. Explain the following components in a small hydro power station: reservoir, weir, penstock and power house. **[2 marks]**
5. Differentiate between a reaction turbine and an impulse turbine for a hydro power plant. Give examples of each. **[3 marks]**
6. You have been asked by the Department of Energy to carry out a complete feasibility study of hydropower station, or biomass fired thermal power plant for a remote rural community. List the main features of such a study, and briefly outline the amount of information you will present as part of your report. **[4 marks]**

SECTION D

[25 Marks]

1. How much flow rate is required to generate 80MW plant if the turbine and generator efficiency is 92% and 90 respectively? Head height is given as 200m with a friction loss of 20m. **[3 marks]**
2. What is Biomass? Give some examples. **[2 marks]**
3. Explain the operating principle of a “**Combined Heat and Power**” thermal power plant. **[3marks]**
4. Explain the operating principle of a “**Combined Cycle Power Plants**” that comprises both gas and steam turbine. **[3 marks]**
5. Tabulate at least 4 fuel properties that a good diesel engine fuel must possess which should be present also in a bio-diesel. **[4 marks]**
6. Heat engines employ several different cycles to convert heat energy to mechanical energy. Discuss the Rankine cycle and Brayton cycle. Label these as either open or closed cycle engines, and comment on their efficiencies. **[3 marks]**
7. Explain the term “**Depth of discharge**” in regards to batteries. **[2 marks]**
8. List down some necessary information regarding batteries. If you are installing a PV system including batteries, what type of battery is generally used? **[3 marks]**
9. What is a hybrid system and provide some applications of such a system? **[2 marks]**

END OF EXAMINATION