



College of Engineering, Science and Technology

**School of Electrical and Electronics Engineering
Trimester 1, 2017**

**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

Total No. of Pages: 5

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. Explain the earth's tilt and the occurrence of the four seasons. **[2 marks]**

2. Sketch the IV & Power curve of a solar cell clearly showing V_{oc} , I_{sc} , V_{mpp} and I_{mpp} . **[3 marks]**

3. Tonga is located at 21.18° South latitude and 175° West longitude. Find the length of day on September 10. **[4 marks]**

4. How does the deployment of Renewable Energy Technologies assist in economic growth? **[2 marks]**

5. What do you understand by the term "*Energy Efficiency*"? State 3 - 4 ways to save energy in your homes and state currently, what are some measures put in place by Department of Energy (Fiji) to embark upon Energy Efficiency. **[3 marks]**

6. For a country which is located in the Southern Hemisphere, comment on the orientation and tilt of the panel to get the optimum output. **[2 marks]**

7. Illustrate and explain a grid connected PV system with battery back-up. **[2 marks]**

8. Differentiate net metering and feed-in tariffs. **[2 marks]**

9. Describe the function of the "SunEye 210 Shade Tool". **[2 mark]**

10. Compare and comment on the outputs of the following modes:
 - Fixed mounted solar panel
 - Solar tracking
 - Adjusting the tilt seasonally**[3 marks]**

SECTION B

[25 Marks]

1. A table containing energy usage information for a small business company is given below:

Tariff Description	Reading type	Meter Number	Reading		Usage	Billed Days
			Present	Previous		
COM Step1	Normal Reading	50158977:1	00006735	00005685	1050	32
Reactive Units	Normal Reading	50158977:2	00003739	00003040	699	32

Table 1.0

To assist you with the bill calculation, the following information is also given below:

Units up to 14,999kWh – cents per kWh per month	39.90 cents
Units over 14,999kWh – cents per kWh per month	41.80 cents

Table 2.0

- Allowed Reactive Energy = $0.62 \times \text{Total kWh}$ (for the relevant billing period). Any reactive power which is used over this calculated 'Allowed Reactive Energy' figure is the 'Excess Reactive Energy' and is chargeable at a rate of \$0.4180 /kVarh.

For the information provided above, calculate the bill for the small business company that has an opening balance of \$20.00 credit (overpaid) showing a step by step calculation and also taking VAT into account. **[6 marks]**

2. The annual energy production from a HAWT is 4.66GWh. Given a 3-bladed 20m radius wind turbine operating in a wind regime with an average wind speed of 12m/s, estimate the power coefficient if it is operating under standard conditions. **[4 marks]**
3. For the system specifications given below, carry out system sizing showing the possible arrangement of batteries and solar PV panels. Also size the inverter and the charge controller **[15 marks]**

Inverter Efficiency = 95%
 Location = Lautoka
 Inverter Voltage = 12V
 BP Solar panel 250W, I = 13.12A

Battery DOD = 60%
 Peak sun hour = 4
 Battery Capacity = 50Ah @ 6V
 Consecutive days without sun light = 2

Load table:

Appliance	AC/DC	Watts	Duty cycle hour/day
5 Lights@12 W each	AC	60	5
TV	AC	45	4
Laptop	AC	120	2
Radio	AC	40	5
Lights	DC	12	4

Table: 3.0

SECTION C

[25 Marks]

1. For the figure given below, write down the name of each component beside the numbers stated on the missing labels. **[5 marks]**

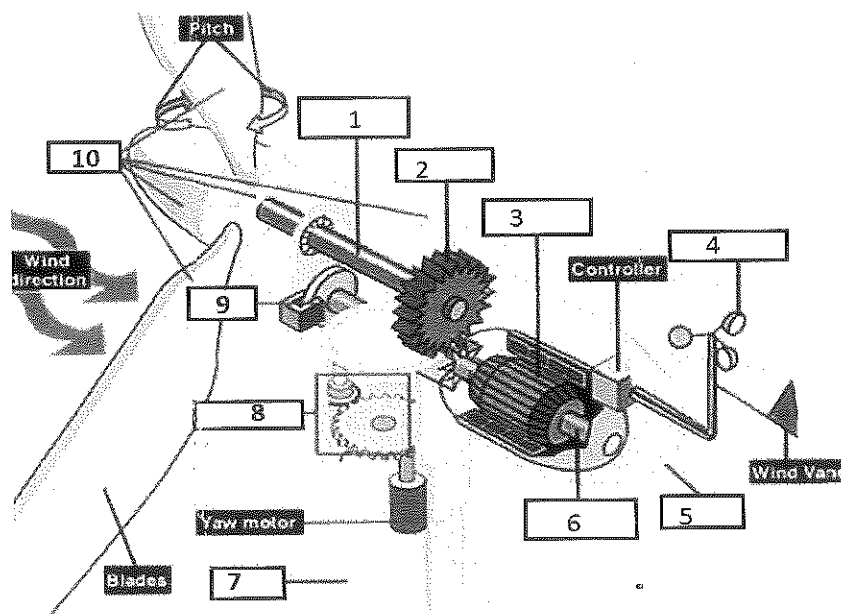


Figure 1.0

2. Draw the power curve of a wind turbine clearly labelling “cut-in” speed, “cut-out” speed and “rated” speed. **[3 marks]**
3. Differentiate off-shore and on-shore wind farms. **[1 mark]**
4. Comment on the effects of a man-made structure located very near to a wind turbine. **[2 marks]**
5. A catchment area of 20km long and 10km width is needed to build a hydro system. With a head height of 300m to dam the turbine can be installed to produce power from the dam. If the region has an annual rainfall of 1200mm and the turbine and generator efficiency is 90% and 95% respectively, calculate the power output of the system. (Take any assumptions necessary) **[6 marks]**

6. A hydro power scheme consists of a storage dam located 60m above the power station. If the head loss in the penstock is 5m,
- What is the velocity of the jet? [2 marks]
 - If the total power delivered by the jets to the 4-jet Pelton Wheel turbine is 500kW, what is the radius of each jet? [4 marks]
7. Differentiate between a reaction turbine and an impulse turbine. Give examples of each. [2 marks]

SECTION D

[25 Marks]

- Define the following terms:
 - bio-fuel
 - pulverizing
 - condenser
 - boiler

[4 marks]
- You have been asked by the Department of Energy to carry out a pre-feasibility study of a grid-connected PV system or a Hydro Power Plant or a Biomass fired steam power plant for a remote rural community. Choose any ONE of the above systems and list the main features of such a study, and briefly outline the amount of information you will present as part of your report. [3 marks]
- Tabulate at least 4 fuel properties of bio-diesel. [2 marks]
- Explain the operating cycle of the following thermal power plants:
 - “Combined heat and power”
 - “Combined cycle power plants”

[4 marks]
- About 3 million tonnes of sugarcane are harvested each year in Fiji over a 6-month period. What power could a bagasse-fired steam generator produce during this period if the overall bagasse to electricity efficiency for this plant is 15%? Assume one tonne of cane produces 0.275 tonnes of bagasse. (Calorific value of bagasse is 15MJ/kg). [3 marks]
- What role does energy storage technologies play in RE integration into the grid? [2 marks]
- Discuss any three energy storage technologies used in renewable energy technologies. [3 marks]
- List down four precautions that should be taken with batteries. [2 marks]
- What are the advantages of a Hybrid System and state any two applications of it? [2 marks]

END OF EXAMINATION