



**School of Electrical and Electronics Engineering
Trimester 1, 2015**

**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. New Zealand is located at 41° South latitude and 174° East longitude. Find the length of day on June 10. **[5 marks]**

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

3. 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? **[3 marks]**

4. For a country which is located in the Southern Hemisphere, comment on the orientation and tilt of the panel to get the optimum output. **[3 marks]**

5. What is a bypass diode? **[2 marks]**

6. How can you obtain solar insolation/radiation data for a particular area and name two instruments used to measure them? **[2 marks]**

7. Illustrate and explain the following systems:
 - i) Stand-alone PV system **[3 marks]**
 - ii) Grid connected PV system **[3 marks]**

1. A portion of an electricity bill for a small business company is given below:

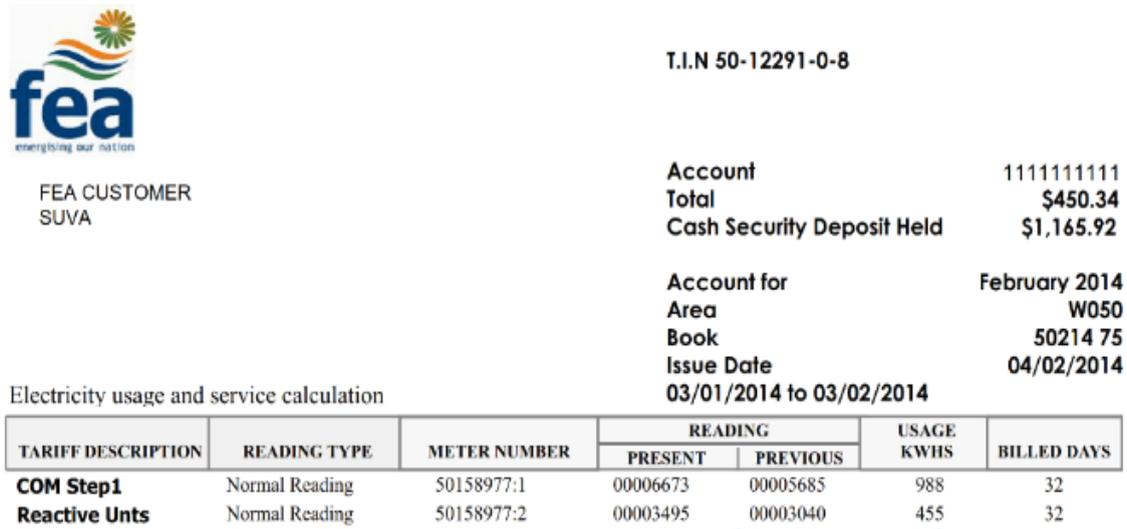


Figure 1.0

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 1.0

- Allowed Reactive Energy = 0.62 x 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 \$3.00 credit (overpaid) showing a step by step calculation and also taking VAT into account. **[6 marks]**

2. 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. **[4 marks]**

3. For the system specs given below, carry out system sizing showing the possible arrangement of batteries and solar PV panels. **[15 marks]**

Inverter Efficiency = 90%

Location = Ba

Inverter Voltage = 24V

BP Solar panel 120W, I = 6.12A

Battery DOD = 50%

Peak sun hour = 4

Battery Capacity = 50Ah @ 6V

Consecutive days without sun light = 2

Load table:

Appliance	AC/DC	Watts	Duty cycle hour/day
4 Lights@10 W each	AC	40	6
TV	AC	40	4
Laptop	AC	150	2
Radio	AC	40	4
Lights	DC	10	4

Table: 2.0

SECTION C

[25 Marks]

1. What is meant by “cut-in speed” and “cut-out speed”? [2 marks]
2. Explain the two types of terrains. Comment on the effects of a man-made structure located very near to a wind turbine. [2 marks]
3. For the Fig given below, write down the name of each component beside the numbers stated on the missing labels. [5 marks]

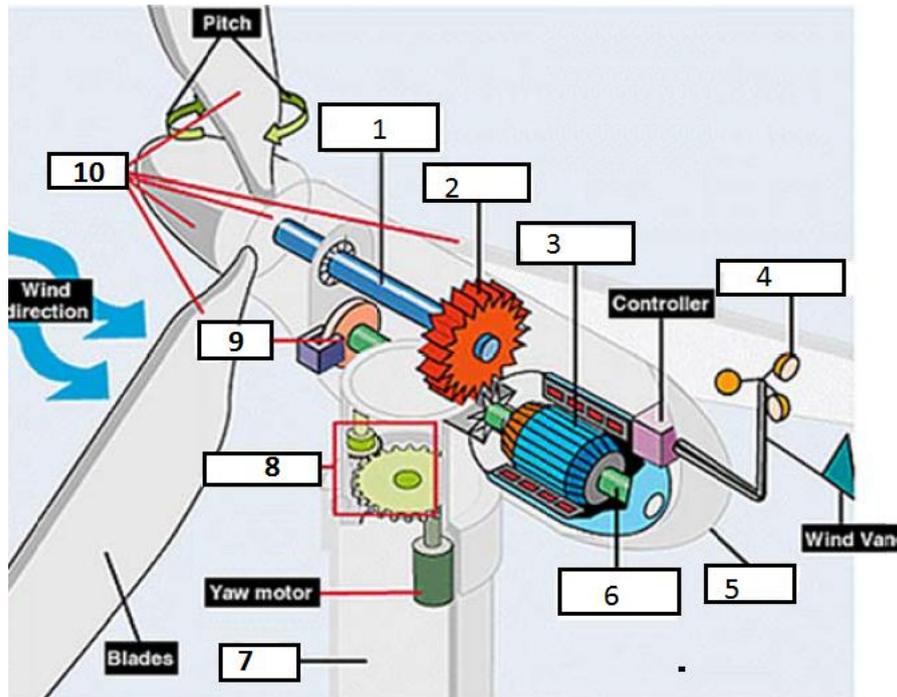


Figure 2.0

4. A catchment area of 40km long and 30km width is needed to build a hydro system. With a head height of 250m the turbine can be installed to produce power from the dam. If the region has an annual rainfall of 3.0m and the turbine and generator efficiency is 90% and 95% respectively, calculate the power output of the system. (Take any assumptions necessary) [5 marks]
5. 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. A 2-jet pelton wheel is to be utilised. If the efficiency of the turbine and the genset of the proposed power station are 90% and 80% respectively, calculate the following:
 - i) The required power input at the jet? [2 marks]
 - ii) What is the flow rate at the jet if there is a head loss of 5m? [2 marks]
 - iii) What will be the velocity of the water at the jet? [2 marks]
 - iv) What will be the cross-sectional area of the jet? [2 marks]
6. Differentiate between a reaction turbine and an impulse turbine. Give examples of each. [3 marks]

SECTION D**[25 Marks]**

1. You have been asked by the Department of Energy to carry out a complete feasibility study of hydropower station 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. **[5 marks]**
2. Tabulate at least 4 fuel properties of bio-diesel. **[2 marks]**
3. Explain the “Combined heat and Power” thermal power plant. **[3 marks]**
4. Biomass could be optimized in a lot of ways for energy generation. Also, many countries are facing difficulties of municipal waste disposal. One such technology that uses municipal waste to generate energy is “Integrated Gasification Combined Cycle Power Plant”? Describe the operating principle of this power plant. **[4 marks]**
5. Explain the principle of operation of a steam turbine such as the one used by FSC and Tropic Woods. **[3 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. **[4 marks]**
7. List down four precautions that should be taken with batteries. **[2 marks]**
8. What is a hybrid system and provide some applications of such a system? **[2 marks]**

END OF EXAMINATION