



College of Engineering, Science and Technology

**School of Electrical and Electronics Engineering
Trade Diploma in Electrical Engineering
(Electrical & Renewable Energy)**

**Supplementary Examination
Trimester 3, 2017**

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. Why should we promote and adapt Renewable Energy Technologies? **[3 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. Samoa is located at 13.83° South latitude and 171° West longitude. Find the length of day on March 10. **[5 marks]**
4. What are the functions of bypass and blocking diodes? **[2 marks]**
5. 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]**
6. Illustrate and explain a grid connected PV system with battery back-up. **[3 marks]**
7. Differentiate net metering and feed-in tariffs. **[2 marks]**
8. Compare and comment on the outputs of the following modes:
 - Fixed mounted solar panel
 - Solar tracking
 - Adjusting the tilt seasonally**[3 marks]**
9. Name one instrument used to measure solar irradiance. **[2 mark]**

1. A portion of an electricity bill for a domestic dwelling is given below:

Tariff Description	Reading type	Meter Number	Reading		Usage	Billed Days
			Present	Previous		
Domestic	Normal Reading	15652:1	00005765	00005685	80	30

Table 1.0

You are provided with the following information:

- Customers who have a combined income of less than \$30,000 and their monthly usage is less than or equal to 100 kWh 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 100 kWh will not qualify for the Government subsidy and will therefore pay the full amount of 33.10 cents/unit.

Suppose the customer qualifies for the subsidy, calculate the bill for the domestic dwelling that has an opening balance of \$1.00 CR 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 radius operating in a wind regime with an average wind speed of 12m/s. assume that the turbine has a power coefficient of 0.4 and 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: 2.0

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

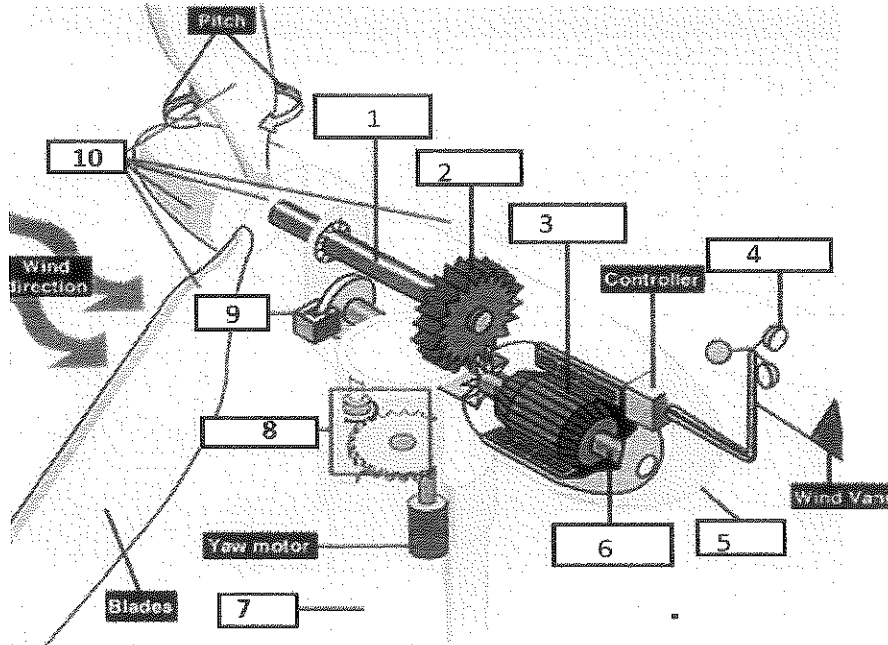


Figure 1.0

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. [2 mark]
4. Comment on the effects of a man-made structure located very near to a wind turbine. [3 marks]
5. 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]
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. [3 marks]

SECTION D**[25 Marks]**

1. Define the term "Biomass". **[2 marks]**
2. Define the following terms:
 - i) bio-fuel
 - ii) pulverizing
 - iii) condenser
 - iv) boiler**[4 marks]**
3. Tabulate at least 4 fuel properties of bio-diesel. **[2 marks]**
4. Explain the operating cycle of the following thermal power plants:
 - i) "Combined heat and power"
 - ii) "Combined cycle power plants"**[4 marks]**
5. 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). **[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. **[4 marks]**
7. Discuss any three energy storage technologies used in renewable energy technologies. **[3 marks]**
8. List down four precautions that should be taken with batteries. **[2 marks]**

END OF EXAMINATION