



**College of Engineering, Science and Technology**

**School of Electrical and Electronics Engineering  
Trimester 1, 2018**

**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.**

1. Briefly elaborate on the global renewable energy progress logistics stating percentage contribution or global capacity of major RE sources. [3 marks]
2. Discuss the social/economic/environmental impacts of Renewable Energy Technologies. [3 marks]
3. Sketch the IV & Power curve of a solar cell clearly showing  $V_{oc}$ ,  $I_{sc}$ ,  $V_{mpp}$  and  $I_{mpp}$ . [2 marks]
4. Find the declination angles and the length of the day on 14<sup>th</sup> November 2017 in:
  - i) Suva (latitude 18.2° South) and in
  - ii) South Korea (latitude 36° North) [5 marks]
5. Elaborate on the reasons of having high household energy bills and how this issue could be encountered? [2 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. Sketch a schematic diagram of a Grid connected PV system connected to AC and DC loads. Describe the operation and function of each components of the system. [3 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. If 10 lights rated at 20W each are operating 6 hours a day for the whole year, how many units of energy will be used up by the lights in a year? [2 marks]

**SECTION B**

**[25 Marks]**

1. 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 = Kadavu*  
*Inverter Voltage = 24V*  
*BP Solar panel 125W,  $I_{mpp} = 6.56A$*

*Battery DOD = 50%*  
*Peak sun hour = 3.5*  
*Battery Capacity = 50Ah @ 12V*  
*Consecutive days without sun light = 2*

Load table:

Appliance	AC/DC	Watts	Duty cycle hour/day
5 Lights@6 W each	AC	30	6
TV	AC	50	4
Radio	AC	40	5
Phone Charger	AC	15	2
Lights	DC	8	4

Table: 1.0

2. 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	00007685	00005685	2000	32
Reactive Units	Normal Reading	50158977:2	00004240	00003040	1300	32

Table 2.0

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

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

Table 3.0

- 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 \$50.00 debit (owing) showing a step by step calculation and also taking VAT into account. **[6 marks]**

3. 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 10m/s, estimate the power coefficient if it is operating under standard conditions. [4 marks]

**SECTION C**

**[25 Marks]**

1. Illustrate and label any 5 major components of a wind turbine. [5 marks]
2. Draw the power curve of a wind turbine clearly labelling “cut-in” speed, “cut-out” speed and “rated” speed. [3 marks]
3. Comment on the effects of a man-made structure located very near to a wind turbine. [2 marks]
4. 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. [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 1100mm 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 3 jet Pelton wheel produces an output power of 4 MW. If the nozzle diameter is 11cm and the head loss is 5% of 290m and the turbine efficiency is 95%,  
i) Find the velocity of the water as it hits the turbine  
ii) The input power of the whole system and  
iii) How much power is lost in the system [5 marks]
7. What type of turbine is a Pelton wheel and state for what type of head and flow rate it is used? [2 marks]

1. Define the following terms:
  - i) biomass
  - ii) furnace
  - iii) pulverizing
  - iv) condenser[4 marks]
  
2. Describe the property "*Flash point*" of a fuel and should it be high or low for a good fuel. [2 marks]
  
3. Explain the operating cycle of the following thermal power plants:
  - i) "Combined heat and power"
  - ii) "Combined cycle power plants"[4 marks]
  
4. 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]
  
5. Discuss any three energy storage technologies used in renewable energy technologies. [3 marks]
  
6. What do you understand by the term "Depth of discharge". [2 marks]
  
7. Degradation of battery capacity depends most strongly on some parameters, state any 2 parameters affecting battery capacity. [2 marks]
  
8. Define Ah rating of battery. [2 marks]
  
9. Explain "Hybrid systems". [2 marks]

*END OF EXAMINATION*