



**School of Electrical and Electronics Engineering  
Semester 1, 2014**

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

**EEE438 – 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. Find the length of the day on 14<sup>th</sup> November 2013 in Suva (latitude 18.2° South) and in Oslo (latitude 60° North) [4 marks]
2. 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. [4 marks]
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. If 10 lights rated at 20W each are operating 8 hours a day for the whole year, how much energy will used up by the lights? [3 marks]
7. Taking the unit price as \$0.35 for the above problem, how much will this cost per year inclusive of 15% VAT. [3 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. [15 marks]

Efficiency = 90%      Peak Sun Hour = 3 h      Battery DOD = 80%      Location = Lautoka  
 System Voltage = 24V      Inverter Voltage = 24V      Battery Capacity = 200Ah @ 24V      Panel Rating = 17.2V, 20A

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

2. Fig 1 shows the I-V characteristics of a water pump and the hourly I-V for a PV module. Once the pump starts running, it needs 8V to keep spinning.  
 a) Sketch the connection set-up of a solar PV Water Pumping that does not utilize the batteries. [2 marks]  
 b) Interpreting the graph below, at what time in the morning will the pump start running? At what time will it stop? Explain your answers. [4 marks]

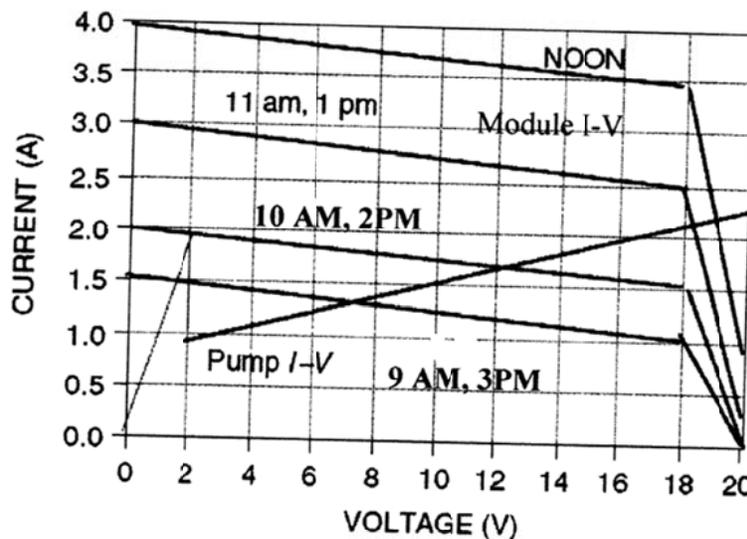


Fig. 1

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. [4 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. [4 marks]
2. For the Fig given below, write down the name of each component beside the numbers stated on the missing labels.

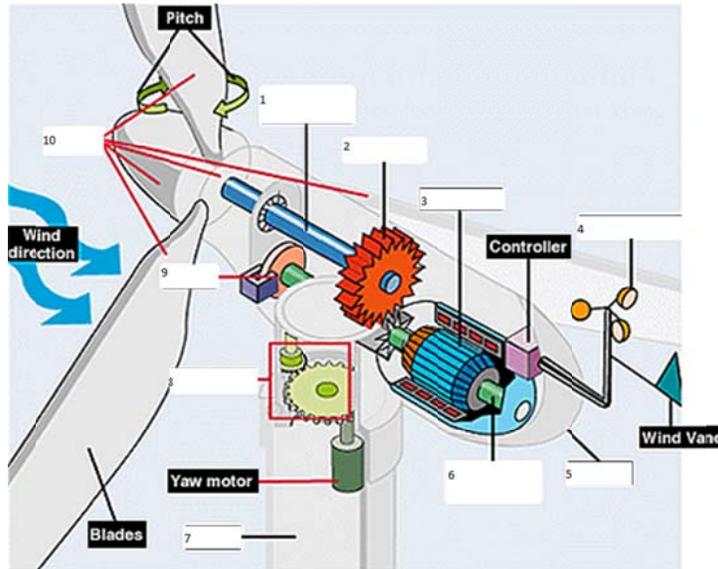


Fig. 2

[5 marks]

3. 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) [7 marks]
4. 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]
5. Explain the following components in a small hydro power station: weir, penstock and intake. [2 marks]

**SECTION D**

**[25 Marks]**

1. Differentiate between a reaction turbine and an impulse turbine. Give examples of each. [3 marks]
2. 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. [5 marks]
3. Tabulate at least 4 fuel properties that a good diesel engine fuel must possess. [4 marks]
4. Explain the principle of operation of a steam turbine such as the one used by FSC and Tropic Woods. [4 marks]
5. 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]
6. 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]
7. What is a hybrid system and provide some applications of such a system? [2 marks]

***END OF EXAMINATION***