UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	RENEWABLE RESOURCES
COURSE CODE	:	DAU 22202
PROGRAMME	:	2 DAU
EXAMINATION DATE	:	JUNE 2015/ JULY 2015
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	A) ANSWER **ALL** QUESTIONS IN **PART A** B) ANSWER **TWO (2)** QUESTIONS ONLY IN **PART B**

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

PART A

Q1 (a) One of the major components of a hydroelectric is the area behind the dam, its reservoir. The water temporarily stored there is called gravitational potential energy. Consider a lake formed behind a dam in a hydropower plant. The turbines are 20.0 m below the surface of the lake whose surface area is 20.0 km^2. Suppose that when the plant pumps water up from the turbine to the reservoir, the water level in the reservoir eventually rises by $d = 0.5$ m. Given $Energy = mgh$ = Density×Area×depth×acceleration gravity×high = $\rho Adgy$ and $E = VIt$

(i) Calculate the energy that has been stored in half meter thick layer.

(6 marks)

(ii) Calculate the number of 12.0 V lead storage batteries rated at 60 Ah that would be needed to store the same amount of energy in Q1(a)(i).

(4 marks)

(iii) Describe the mechanism involved in reservoir as stored energy.

(6 marks)

(b) A storage tank containing molten salt initially at 300 °C is used by a solar thermal power plant to generate electricity. The plant requires a minimum salt temperature of around 150 °C in order to generate steam to power a turbine. The cylindrical storage tank is 9.0 m high and 24.0 m in diameter. Assume a 30% efficiency ($e = 0.3$) and density, ρ of salt is 2300 kgm^{-3} and specific heat, $c = 1800$ $J°C^{-1}$. Calculate the time of the thermal energy in salt would be able to produce electricity in a 100 MW power plant.

Given $E = mc\Delta T$, $m = \frac{\rho \pi d^2}{4}$ and time, $t = \frac{eE}{P}$

(9 marks)

Q2 (a) Among technologies for deriving electrical power from the ocean include tidal power, wave power, ocean thermal energy conversion (OTEC) and geothermal energy.

(i) Differentiate the four alternatives energies.

(8 marks)

(ii) Choose one of the alternative energy and illustrate the mechanism that consists of concept using word and diagram to support the description.

(9 marks)

(iii) List the advantages and disadvantages of the energy of your choice for Q2(a)(ii).

(8 marks)

PART B

Q3 (a) Electricity generation using solar thermal is among the fastest growing renewable energy applications. The two primary ways of harvesting solar energy use either solar collectors that convert the incident solar radiation into heat or photovoltaic cells that convert incident solar radiation into electricity. One of the example of solar thermal is an evacuate tube collector as shown in **FIGURE Q3 (a)**.

(i) Describe the flow process of an evacuate tube collector with reference to heat pipe, absorber plate, heat transfer and individual evacuated tube.

(6 marks)

(ii) Differentiate between active systems and passive systems of water heating using a diagram to support the description.

(4 marks)

(b) Photovoltaic (PV) cells look similar to solar panels but they work in a different way. Solar panels are used to produce hot water or even steam. Photovoltaic panels convert the sunlight directly into electricity. A solar PV cell basically consists of a slab of semiconductor with one or more *pn*-junction as shown in **FIGURE Q3 (b).**

(i) Name the six (6) components of a typical solar cell and two (2) impurities that were added to the base.

(8 marks)

(ii) Illustrate the mechanism of the solar cell and the function of impurities.

(7 marks)

Q4 (a) Water has been used to power industry for hundreds of years. The water wheel being driven round by a river or stream. This was the main form of power during the early years of the industrial revolution.

(i) Describe how the rotating wheel is converted into usable power.

(4 marks)

(ii) Discuss the advantages of having a dam when used in conjunction with a water wheel.

(6 marks)

(b) Hydro power is an alternative way of producing electricity from the power produced by water under pressure. A typical setup requires the construction of a dam. This would be situated at the head of a valley. Behind the dam, water is allowed to build up forming a large, deep lake. The deeper and larger the lake, the greater the potential of producing large amounts of electricity. A typical dam with electricity power set up is shown in **FIGURE Q4 (b).** Write a description of the way electricity is produced based on the diagram to support the description.

(15 marks)

Q5 Wind turbines convert kinetic energy in the wind into mechanical power. This mechanical power can be used for specific task such as grinding grain or pumping water while generator can convert this mechanical power into electricity. Most large modern wind turbines are horizontal axis turbines (HAWT) as shown in **FIGURE Q5**. There are numerous ways to describe a wind turbine such as rotation axis, rotation speed, number of blades, solidity, power rating, nature of motor mounting, wind speed, purpose and dominant driving force.

(a) Label all parts of horizontal axis turbines (HAWT).

(7 marks)

(b) Discuss the functions of the part components in Q5 (a)(i).

(12 marks)

(c) For a commercial wind turbine, typical value coefficient is known as C_p or rated power of turbine. Calculate a typical turbine blade diameter if an engineer want to plant a wind turbine with power of 10MW.
Given $C_p = 0.4$, rated wind speed, $v = 14.0$ ms^{-1}, density of air taken, $\rho = 1.23$ kgm^{-3}, $P = \frac{1}{2}C_p\rho A v^3$.

(6 marks)

Q6 Bio-products are industrial and consumer goods manufactured wholly or in part from renewable biomass. The thousands of industrial bio-products produced today can be categorized into five major areas such as sugar and starch bio-products, oil and lipid based bio-products, gum and wood chemicals, cellulose derivates, fibers and plastics and industrial enzymes.

(a) Fermentation is a series of chemical reaction that convert sugars to ethanol. This reaction is caused by yeast or bacteria which feed on the sugars. Show the flow diagram for production of ethanol from corn.

(11 marks)

(b) In addition to advanced fuels, biomass can also be used for the production of biodiesel. This can be done in several ways such anaerobic digestion. Show the flow diagram for production of methane using anaerobic digestion.

(14 marks)

~ END OF QUESTION ~

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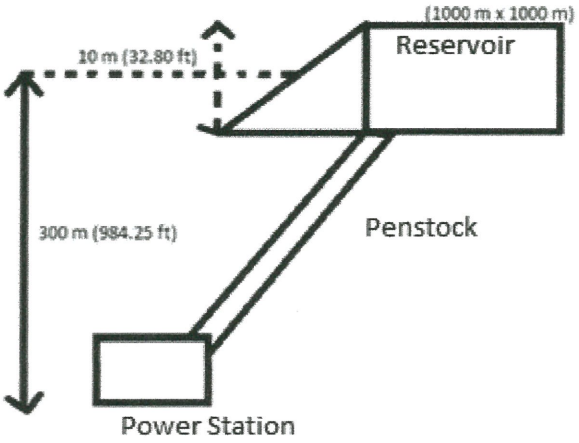

FIGURE Q1(a)

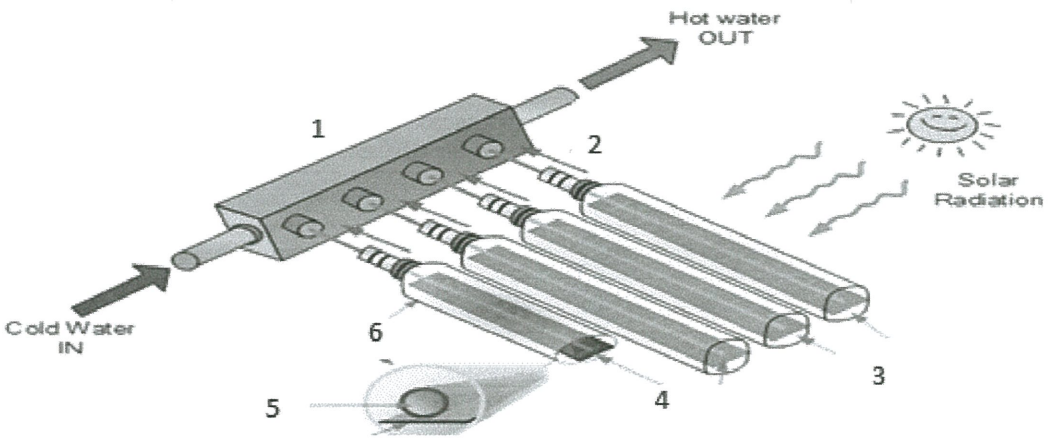

FIGURE Q3(a)

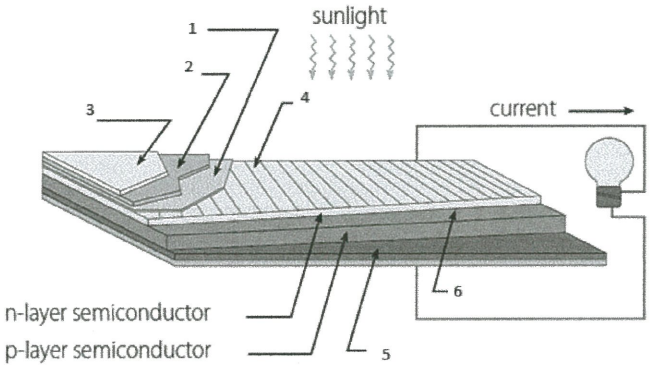

FIGURE Q3(b)

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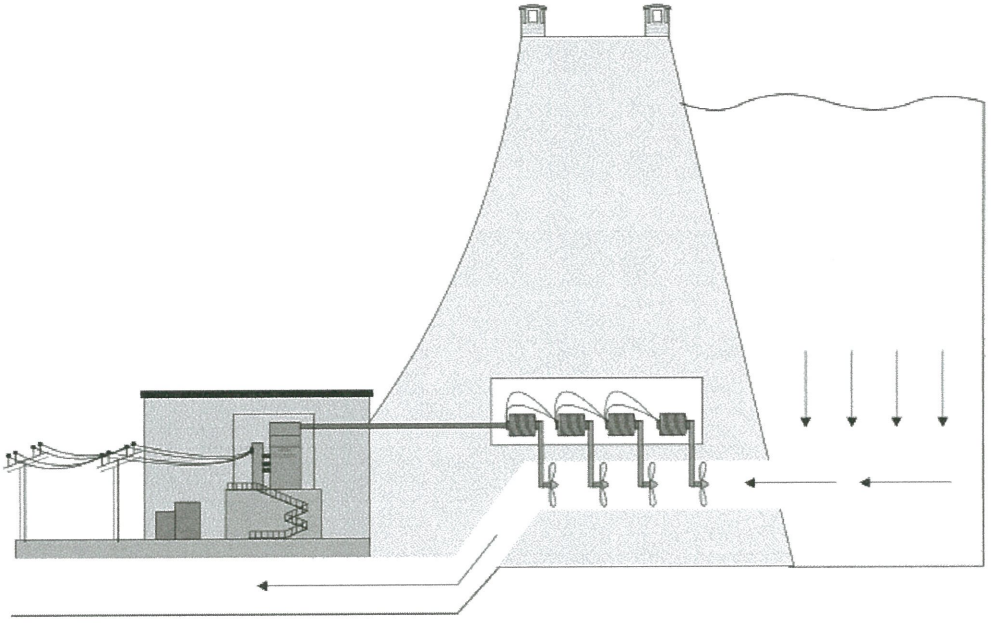

FIGURE Q4 (b)

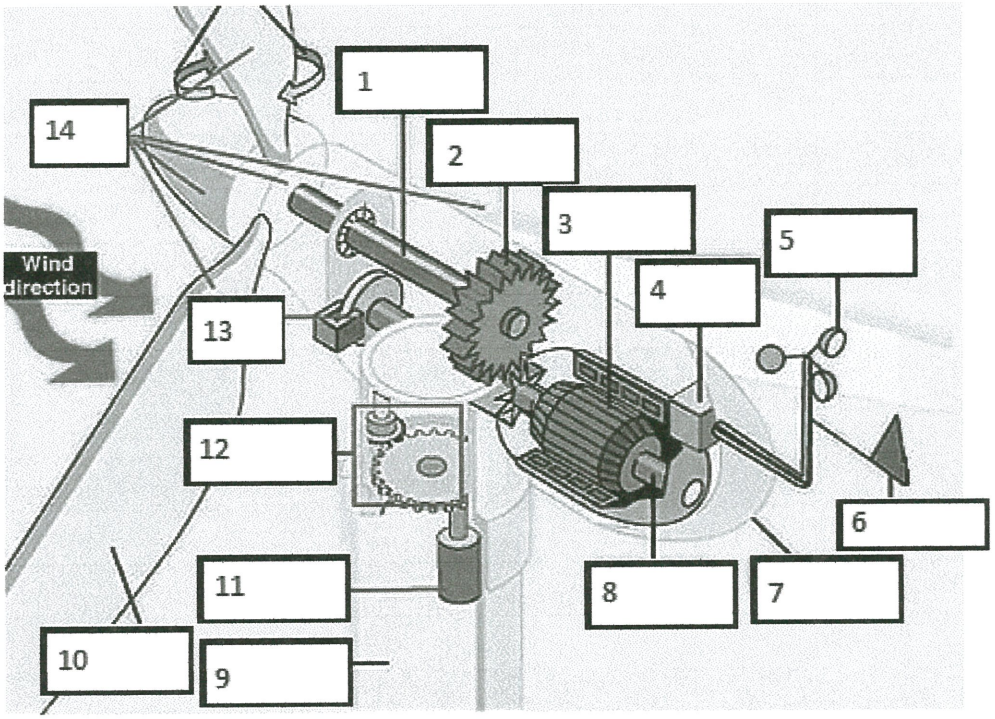

FIGURE Q5