Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(TAKE HOME)
SEMESTER I
SESSION 2020/2021

COURSE NAME	:	RENEWABLE ENERGY
COURSE CODE	:	BNE 34203
PROGRAMME CODE	:	BNE
EXAMINATION DATE	:	JANUARY/FEBRUARY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS **OPEN BOOK EXAMINATION**

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) Renewable energy is generally defined as energy that comes from resources. List **FOUR (4)** types of renewable energy.

(4 marks)

(b) List and explain **FOUR (4)** reasons why Renewable Energy is so important to worldwide.

(8 marks)

(c) Define Net Energy Metering (NEM) with an example, type of installation and capacity limits that needs by Sustainable Energy Development Authority of Malaysia.

(8 marks)

Q2 (a) Define what Wind Turbine is and list **TWO (2)** types of them.

(4 marks)

(b) Sketch **FOUR (4)** types of Vertical Axis Wind Turbine (VAWT)

(8 marks)

(c) A hydroelectric power station is supplied from a reservoir with area of 2.4 km^2 and capacity $5x10^6$ m^3. The effective head of water is 100 m, the penstock, turbine and generation efficiencies are 95%, 90% and 85%, respectively.

(i) Calculate the total electrical energy that can be generated from the power station.

(4 marks)

(ii) If the load of 15000 kW has been supplied for 3 hours, predict the fall in reservoir level. Given, level of reservoir = $\frac{v}{A}$

(4 marks)

Q3 (a) Fuel cell is an electrochemical device, closely related to the battery, which harnesses a chemical reaction between two reagents to produce electricity.

(i) Sketch a diagram that explain the principle of fuel cell occurred at anode and cathode in order to produce electricity.

(3 marks)

(ii) Compare the reactions that occur at anode and cathode including the simple chemical formula.

(4 marks)

(iii) Identify fuel cell type with the lowest temperature.

(1 mark)

(b) The monthly solar irradiation at site is given in the **Table Q3 (b).**

Determine the following:

(i) Total solar irradiation, H in units of $kWhm^{-2}$

(2 marks)

(ii) Total solar irradiation, H in units of MJm^{-2}

(2 marks)

(iii) Annual Peak Sun Hour, *PSH*

(2 marks)

(iv) Average daily *PSH* for the whole year

(2 marks)

(v) *PSH* for the month of May

(2 marks)

(vi) Average daily *PSH* for May

(2 marks)

Q4 (a) A company of aquaponics needs a stand-alone solar power system for supplying their loads based on usage hour as in **Table Q4 (a)** with the following data:

Autonomy day	: 2 days,
System loses	: 10%,
Peak sun hours	: 4 PSH,
PV Module	: Poly 200 w,
Battery	: 12V 250 Ah Gel,
Depth battery discharge	: 60%

You as a technologist solar expert are required to calculate & propose 48 Vdc solar balanced of system (BOS) as below:

(i) Total Numbers of Solar Panel needed (refer **Figure Q4 (a)**)

(5 marks)

(ii) Inverter Sizing

(5 marks)

(iii) Solar Charger Controller

(5 marks)

(iv) Battery needed

(5 marks)

Q5 (a) Several Orang Asli's families lived near 750 meter height of waterfalls with 12.5 liter per second (l/s) of flowrate and 650 meter long beside the waterfalls without electricity.

A NGO community service approached and appointed you as a technologist hydro expert to help on design and build a suitable hydro system using their sponsored generator, IREM generator from Italy.

By referring to all data and IREM Hydro Power Range given in **Figure Q5(a)**, you are require to propose the most suitable hydro system in kW that will runs 24 hours non-stop by:

(i) Define suitable hydro turbine based on **Figure Q5 (a)**

(5 marks)

(ii) Calculate Total Load Demand for each house based on **Table Q5 (a).**

(5 marks)

(iii) Calculate how many houses that can be supplied by your hydro power designed.

(5 marks)

(iv) Illustrate layout plan from water source, piping, turbine house and supplied loads.

(5 marks)

- END OF QUESTIONS –

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Table Q3 (b): Monthly Solar Irradiation Data

Month	H(kWhm^{-2})		Month	H(kWhm^{-2})
Jan	125		Jul	138
Feb	130		Aug	142
Mar	150		Sep	150
Apr	140		Oct	152
May	135		Nov	130
Jun	136		Dec	125

Table Q4 (a): Aquaponics Load

No.	Items	Quantity	Watts	Usage in Hours
i.	LED Lights (Orange Color)	20	15	8
ii.	Motor Pump 1	2	746	1
iii.	LED Flood Light	2	50	6
iv.	13A Socket Outlet	2	500	2

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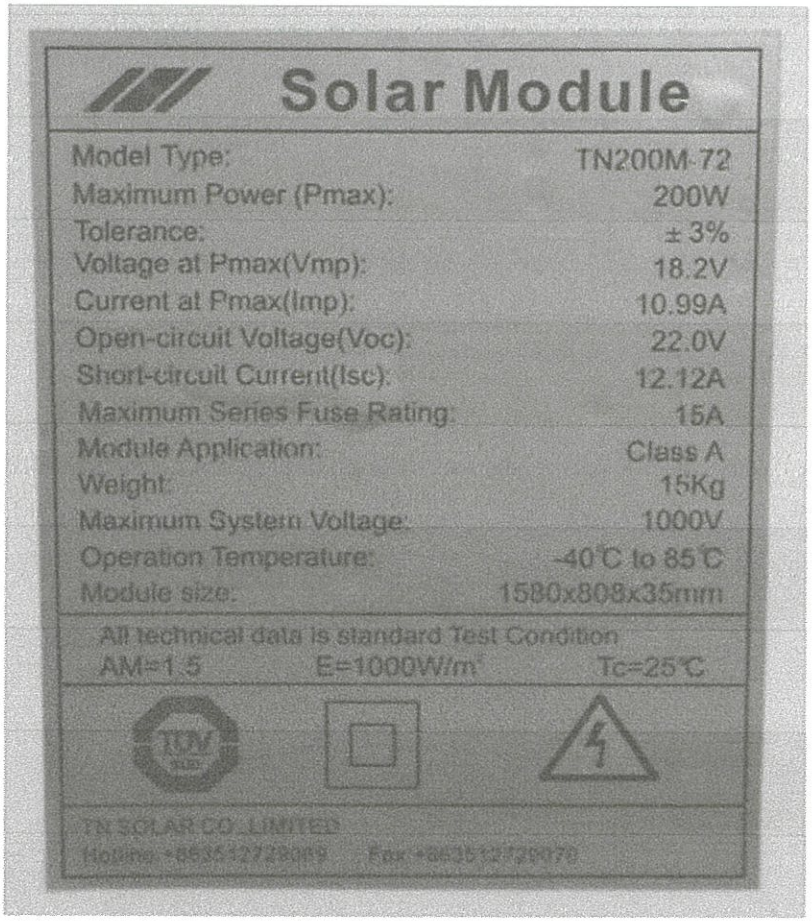

Figure Q4 (a): Solar Panel Specification

Table Q5 (a): Orang Asli`s Load Demand per house

No.	Items	Quantity	Watts	Usage in Hours
i.	LED Lights	8	20	8
ii.	Table Fan	4	30	1
iii.	LED Flood Light	1	100	6
iv.	13A Socket Outlet	3	500	4

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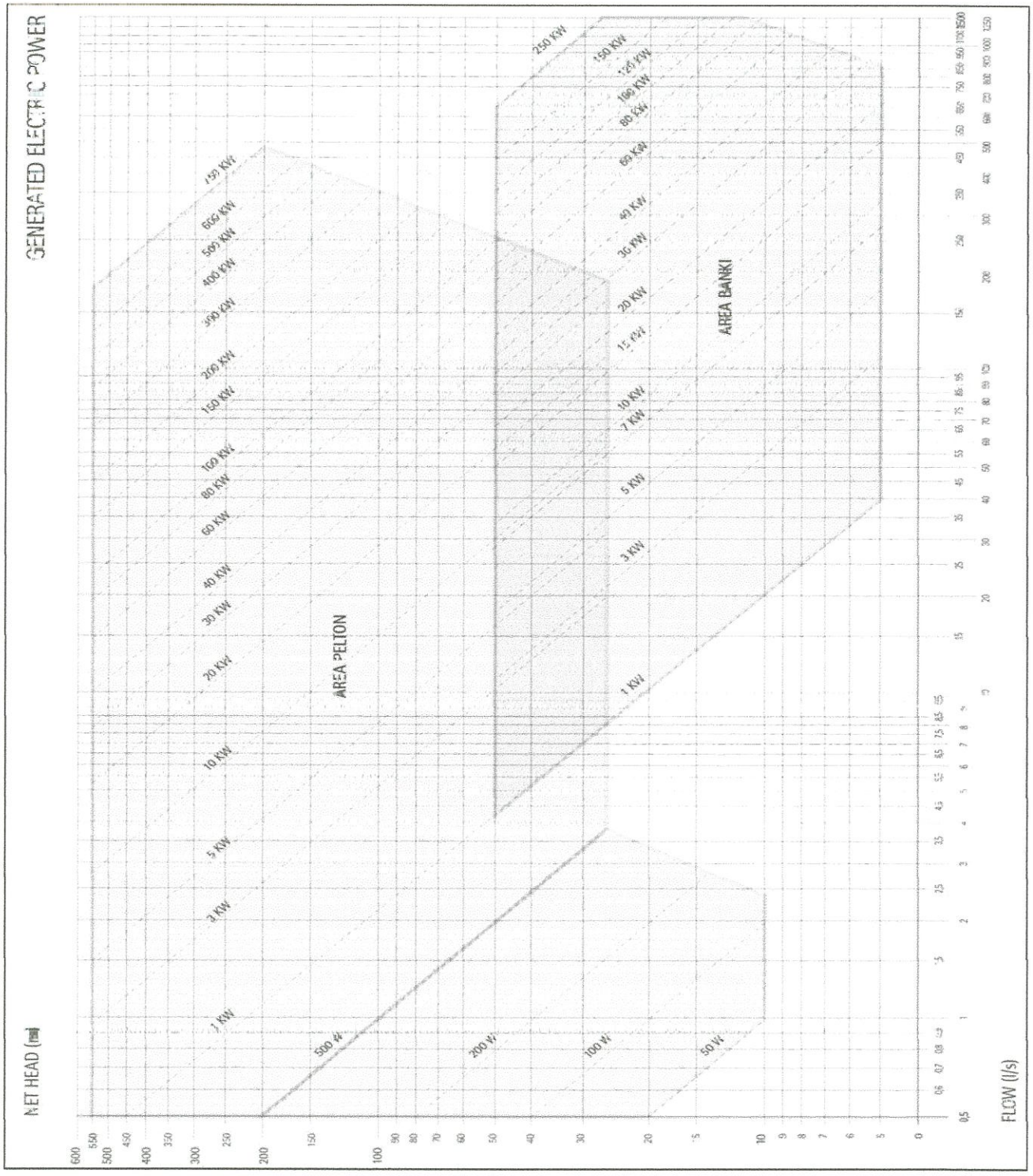

Figure Q5 (a): IREM Hydro Power Range