Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME	:	SUSTAINABLE AND RENEWABLE ENERGY
COURSE CODE	:	MDL 10403
PROGRAMME CODE	:	MDL
EXAMINATION DATE	:	JANUARY/ FEBRUARY 2022
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL QUESTIONS** 2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **OPEN BOOK**

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

Q1 **(a)** The rate of decline in carbon emissions has fallen by over 6% last year. This is similar to what the world needs to average each year for the next 30 years to be on track to meet the aims of the Paris Agreement. Evaluate the significant of this trend to the current situation.

(10 marks)

(b) Biomass conversion through burning matter is particularly harmful to the environment. The forests is burned for electricity. Harvesting wood for energy production worsens climate change immediately, and the harms it causes can persist for many decades or even centuries. Write a conclusive discussion regarding this matter.

(10 Marks)

Q2 **(a)** Geothermal resources span a wide range of heat sources from the earth. Write the potential of geothermal energy in Malaysia.

(10 marks)

(b) Geothermal energy is a type of renewable energy taken from the Earth's core. It comes from heat generated during the original formation of the planet and the radioactive decay of materials. Even though there are available in many countries, there has been a major issue since the early days of geothermal development. Evaluate the elements below:

(i) Geothermal resources assessment;
(ii) Geothermal Energy: Geological explorations.

(10 marks)

Q3 **(a)** Recent projections predict that the primary energy consumption will rise by 48% in 2040, with 80% of the main energy resources from conventional energy (Fossil fuel) resources that contributes to greenhouse gas emission, global warming, and unsustainable global environment. Renewable solar energy is globally available in huge amount and with improving technology to process and convert the energy into more useful forms. This rapidly evolving solar technologies (solar photovoltaic, concentrating solar power and thermal energy) has shown that solar thermal energy can supplement and substitute conventional fossil fuel usage. Describe how the following limitations and barriers can impact solar thermal energy:

(i) Cost (High initial cost of material and installation);
(ii) Long Return on Investment (ROI);
(iii) Low technology performance (efficiency);
(iv) Energy Intermittent (Cloudy weather and nighttime); and
(v) Government policy

(6 marks)

(b) A home in Keysborough is located at about 33 °N of Adelaide (Australia). The home requires about 62 kWh of heat on a winter day to maintain a constant indoor temperature of 20 °C. Where the heat capacity of water is 1 kcal/kg/°C, collector outlet and inlet water temperature 60 and 20 °C, respectively, and average solar radiation 6.5 kWh/m2/day. Determine

(i) the collector surface area does it need for an all-solar heating system that has a 20% efficiency; and
(ii) the storage tank size has to be to provide this much energy.

(6 marks)

(c) Universiti Tun Hussein Onn Malaysia (UTHM) has a captivating landscape and green environment. The university management has put serious effort and commitment towards making the campus and its ecosystem more sustainable. In UTHM, the library is among the buildings with high energy consumptions rate. Located at 1°51'26.9"N103°04'54.4"E, in the city of Parit Raja, Johor. A five-story building with a total floor area of 16000m² and capacity of 4000 students. Provided with the data in **Table Q3(c)**, advise the Sustainable Campus Office (SCO), UTHM on the prospect of using solar photovoltaic (PV) as alternative energy sources to generate part of the library annual energy consumption. The average sunshine hour in the district of Parit Raja is 6 hours, the emission factor as 0.000667 CO_2/kWh, and solar panel wattage 350 watts (W). To make UTHM campus more environmentally friendly, determine the following:

(i) Calculate the annual greenhouse gas emission carbon dioxide (CO_2) from the library.
(ii) Determine the number of solar panels required to generate 45% of the annual energy consumption in the library.
(iii) Calculate the Return -On-Investment (ROI) on implementing solar PV as alternative energy sources for the UTHM library if the total cost of purchase, installation, maintenance and other miscellaneous is put at million Malaysian Ringgit (MYR).

(8 marks)

Q4 (a) A site evaluated for a wind farm is observed to have steady winds at a speed of 8.5 m/s. Determine the wind power if the rotor radius is 15 m and the air density is 1.12 kg/m^3.

(5 marks)

(b) Two sites are being considered for wind power generation. In the first site, the wind blows steadily at 7 m/s for 3000 hours per year, whereas in the second site the wind blows at 10 m/s for 1500 hours per year. Assuming the wind velocity is negligible at other times for simplicity, determine which is a better site for wind power generation if a wind turbine with 30 m radius is installed at both sites, as shown in **Figure Q4(b)**. Take the air density to be 1.25 kg/m^3.

(15 marks)

Q5 **(a)** Define wave energy and describe three main existing technologies to extract energy from the wave with the aid of diagrams.

(10 marks)

(b) The potentials of wave power vary from one place to another. A wave energy converter is usually used to exploit the wave power for electricity generation, water desalination, or pumping water. If the maximum height of the wave is 2 m, determine the power extracted per meter from a water wave after a quarter of a minute.

(3 marks)

(c) A hydroelectric power plant is being designed. The gross head from the reservoir to the tailrace is 165 m, and the water flows through the turbine at the velocity of 80 m/s at 25°C (density =988kg/m3, g=9.81m/s2). If the turbine has an efficiency of 95.2 percent, and all other mechanical energy losses (through the penstock, etc.) are estimated to reduce the output by 3.5 percent. The generator itself has an efficiency of 94.5 percent. Estimate;

(i) The volume flow rate of the water through the 60 cm diameter penstock; and
(ii) the electric power production from the plant in MW.

(7 marks)

– END OF QUESTIONS –

FINAL EXAMINATION

SEMESTER/SESSION: SEMESTER I 2021/2022 PROGRAMME : MDL
COURSE NAME : SUSTAINABLE AND RENEWABLE ENERGY COURSE CODE : MDL 10403

Table Q3 (c): UTHM Utility Data For Tunku Tun Aminah Library, 2017

Month	Electricity Consumption (kWh)	Carbon Emission (CO_2)	Amount (RM)
January	367165.03	5439.72	134015.2359
February	347887.83	5491.23	491979.0579
March	427034.77	5852.42	155867.691
April	418362.27	5632.61	152702.2285
May	414332.33	5589.72	151231.3004
June	352627.77	5265.34	128709.136
July	354577.38	5309.42	129420.7437
August	305476.89	5103.84	111499.0648
September	314569.22	5221.14	114817.7653
October	407271.52	5671.11	148654.0975
November	400905.43	5602.33	146330.4819
December	373688.43	5231.16	136396.2769
Total	5483898.85	3674.21223	2001623.08

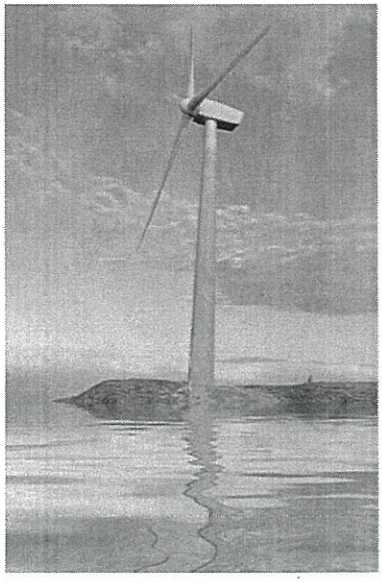

Figure Q4(b) : Wind Turbine