University of Ruhuna- Faculty of Technology

Bachelor of Engineering Technology

Level 2 (Semester 1) Examination, November 2019

Course Unit: ENT 2132 - Renewable and Alternative Energy Technology

Time Allowed: 2 hours

Answer all **Four (05)** questions. Calculators are allowed to use for calculations.
[All symbols have their usual meaning]

Q1)

(a) Briefly describe the function of a solar panel when generating electricity.

[3.0 Marks]

(b) What is meant by the **maximum power point voltage**?

[2.0 Marks]

(c) State **four** derating factors which need to be considered when designing a solar system.

[2.0 Marks]

(d) Calculate the required number of solar panels for a Sri Lankan house which uses electrical appliances listed the **Table Q1 (d)** given below. Assume that the typical value of sun-hours of Sri Lanka is 3.8 and the capacity of a solar panel is 10 W.

Table Q1 (d): Details of electrical appliances and their daily usage

Appliance	Power Rating (W)	Time of operation per day (mins)
TV	20	120
Radio	10	300
Water pump	20	20
Main light	30	180
Spot light	10	60

[3.0 Marks]

Q2)

(a) Briefly explain the function of each of the following components of a hydroelectric power plant scheme.

i. Penstock
ii. Surge tank

[2.0 Marks]

(b) Briefly explain the concept of **pumped storage hydroelectric power** and state one of its key applications.

[2.0 Marks]

(c) State the **two** main types of turbines used to extract hydropower and briefly explain the differences between them.

[2.0 Marks]

(d) What are the main parameters which will determine the amount of power generated from a hydroelectric power plant?

[1.0 Marks]

(e) In a hydroelectric power plant, the dam is 360 ft high, the water head (distance the water falls) is 250 ft and the typical water flow rate is 3000 cfs. Assuming that the overall efficiency of the turbine and generator unit is 80%, calculate the power that can be generated by this plant.

[3.0 Marks]

Q3)

(a) What are the main types of **oceanic energy sources**?

[1.0 Marks]

(b) Tidal range of tide at an oceanic place is 10 m and the surface of the harnessing plant is 9 km^2. Assuming that the power conversion efficiency to be 30%, calculate the daily and yearly average power generation of the plant in MW. Assume that the potential energy of the low tide is zero and there are 706 tidal cycles per year (12 hrs and 24 min per a tidal cycle). Required equation with usual notation is given below.

$$E_T = \frac{\eta R^2 \rho A g}{2}$$

Here, the gravitational constant (g) is 9.81 m/s^2 and the density of sea water (ρ) is 1025.00 kg/m^3.

[5.0 Marks]

(c) Briefly explain following terms with the aid of clear sketches.

i. Forward osmosis
ii. Pressure-retarded osmosis
iii. Osmotic equilibrium
iv. Reverse osmosis

[4.0 Marks]

Q4)

(a) Explain what is meant by the **sustainability of biomass resources.**

[1.0 Marks]

(b) What are the main biomass conversion technologies?

[2.0 Marks]

(c) Briefly explain the gasification process of solid biomass.

[2.0 Marks]

(d) Briefly explain the operation of a biomass integrated gasifier combined cycle with the aid of a clear sketch.

[1.0 Marks]

Q5)

(a) A factory has 50 number of 100 W incandescent lights for in door lighting purposes. These are to be replaced by 10 W LED lights. Normal daily operating hours of the lights are from 6.00 pm to 10.00 pm and from 4.00 am to 7.00 am. The cost of one LED light is Rs. 1000.

i. Calculate the expected energy savings by switching to LED lights.

[2.5 Marks]

ii. Calculate the monthly cost saving by switching to LED lights, assuming the unit cost of energy as Rs. 10 /kWh.

[0.5 Marks]

iii. Calculate the payback period of switching to LED lights, assuming that each 100 W incandescent light has a second market of Rs. 100.

(Payback period in months = Total cost of replacing lights/ Monthly cost saving)

[2.0 Marks]

(b) In a household, **five** 50 W incandescent lights are to be replaced by the same number of 7 W LED lights. The Average monthly electricity consumption of the household can be taken as 120 units (120 kWh). Normal daily operating hours of the lights are from 6.00 pm to 10.00 pm and from 4.00 am to 7.00 pm. Use the electricity tariffs given in **Table Q5** and calculate the following.

i. The monthly energy saving expected from the proposed replacement of the lights.

[2.5 Marks]

ii. The expected monthly cost saving by this particular lighting upgrade.

[2.5 Marks]

Table Q5: Electricity tariffs

Monthly Energy Consumption (kWh)	Unit Charge (Rs. / kWh)	Fixed Charge (Rs. / month)
0-60	7.85	0.00
61-90	10.00	90.00
91-120	27.75	480.00
121-180	32.00	480.00