



University of Ruhuna- Faculty of Technology
Bachelor of Engineering Technology Honours
Level 2 (Semester 2) Examination, March - April 2021

Course Unit: ENT2132 Renewable and Alternative Energy Technologies
Duration: 2 hrs

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- Answer all **Four (04)** questions.
- State your Index number in each page of your answer book and in additional papers.
- Clearly write the questions numbers when answering and your answers will not be marked if you haven't mentioned them.
- In your calculations, take gravitational acceleration (**g**) as **9.81 ms⁻²**.

Q1.

- a) Identify main components of a hydroelectric power plant in a clear sketch and state the function of each component. (10 Marks)
- b) Explain the main two types of turbines used in hydroelectric power plants with their applications. (05 Marks)
- c) In a given small-scale hydro power generation plant of 100 kW capacity, the flowrate of the water stream is found to be varying between $10 \text{ m}^3/\text{s}$ to $16 \text{ m}^3/\text{s}$ over the year. If the power generated by a hydroelectric power plant is given by the following equation, while taking the efficiency of the plant as 90% and the density of water as 1000 kg/m^3 , calculate the following.

$$P = \eta \rho Q H g$$

- P — Power generated in (W)
 ρ — Density of water (kg/m^3)
 η — Efficiency of the power plant
Q — Flow rate of water (m^3/s)
H — Effective height of the dam (m)
g — Gravitational acceleration (m/s^2)

- I. Calculate the required **effective height** of the dam in order to maintain a minimum power generation rating of 100 kW.
- II. Calculate the **maximum power** generated from the plant with the calculated height of the dam. (10 Marks)

Q2.

- a) State and briefly explain the main two types of nuclear reactions that will occur at the atomic scale. (08 Marks)
- b) Identify the main two types of nuclear reactors used in nuclear power generation and explain their main differences. (06 Marks)
- c) Briefly explain the functions of the following components in a nuclear reactor.
- I. Reflector
II. Control rods
III. Moderator (06 Marks)
- d) Sri Lankan government has decided to build a nuclear power station in Sri Lanka in 2030. Describe suitability of the proposed power plant by considering benefits and drawbacks. (05 Marks)

Q3.

- a) Oceanic energy can be classified into five main categories. Out of the five categories, recommend the most exploitable oceanic energy source for Sri Lanka. Justify your answer. (02 Marks)
- b) You are required to identify a suitable site to install a sea wave energy generator. Identify the ideal characteristics of sea waves and factors that need to be considered when selecting the suitable site for the installation. Mechanical power of a sea wave per full wavelength is given by the following formula.

$$P = \frac{\rho g^2 H^2 T l}{32\pi}$$

- P – Power of sea wave present in depth (W)
g – Gravitational acceleration (9.81 ms^{-2})
H – Wave height (m)
l – length of the wave (m)
T – Sea wave period (s)
 ρ – Density of sea water (kg/m^3)

(08 Marks)

- c) You have been assigned to identify suitable potential sites to carry out a Pilot Tidal Barrage power generation scheme. Calculate the tidal pool area (A) requirement of the plant, assuming that maximum tidal range occurring around Sri Lankan coastal area is about 2 m and the tidal barrage has a yearly average power generation of 5 MW. Average energy content of a tide per a tidal cycle in kWh is given by the following equation. For the calculation, also assume that there are 706 tidal cycles per year.

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

- E – Energy of a tide per tidal cycle (kWh)
R – Tidal range (m)
A – Area of the tidal pool (km^2)
g – Gravitational acceleration (ms^{-2})
 ρ – Density of sea water, (1025 kg/m^3)
 η – capacity factor, (40%)

(10 Marks)

- d) Define the term osmotic pressure with the aid of a suitable sketch. (02 Marks)

- e) Explain the difference between pressure retarded osmosis and reverse osmosis, based on the osmotic pressure. (03 Marks)

Q4.

Details of electrical appliances and their daily usage of a household is given in the table Q4 (a). You are required to carry out a simple energy audit to identify suitable ways to minimise the monthly energy cost of this household.

Table Q4 (a): Details of electrical appliances and their daily usage in a household

Name of the Appliance	Power Rating (W)	No of Appliances	Time duration of operation per day (hrs)
LED TV	50	1	4.0
Washing Machine	500	1	3.0
Refrigerator	150	1	24.0
Indoor Lights	50	5	7.0
	20	5	6.0
Outdoor Lights	100	2	7.0
Electrical Kettle	2000	1	0.5
Electrical Iron	1000	1	0.5
Wi-Fi Router	5	1	24.0
Personal Computers	150	2	2.0
Electrical Fans	50	5	12.0
Electrical Mixer Grinder	750	1	0.5

- a) Calculate the monthly energy consumption of the household. (05 Marks)
- b) Calculate the monthly energy cost of the household, based on the electricity tariffs given in Table Q4(b). (05 Marks)

Table Q4(b): 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
>= 181	45.00	540.00

- c) Suggest ways of minimising the energy cost for the household. (05 Marks)
- d) Calculate the estimated monthly energy cost after implementing your suggestions. (10 Marks).