



# UNIVERSITY OF RUHUNA

## Faculty of Engineering

End - Semester 7 Examination in Engineering: July 2016

Module Number: ME 7312

Module Name: Energy Technology

[Three Hours]

[Answer all questions, each question carries ten marks]

**Q1.** As a Project Engineer you are requested by the management of your organization to design a coal power plant which is expected to generate 500 MW electric power and to be connected to the grid.

By using your expert knowledge on coal power plants discuss the main areas you want to consider to make the project an economically and technically viable, environmentally friendly without disturbing the lives of the people living around the project location.

In your answer you may consider following:

- i. Selection of location
- ii. Selection of raw material (fuel), supply, transport, loading, unloading, preparation.
- iii. Suitable technology for generation of steam and power (Boiler, Generator etc.)
- iv. Feed water, Cooling water, Air Supply, etc.
- v. Emission Control and Treatment
- vi. Waste Water Treatment
- vii. Waste Disposal
- viii. Environmental Impacts
- ix. Social Impacts
- x. Health hazards

[10 Marks]

**Q2. (a)** Describe the operation of a hydropower plant using an appropriate sketch.

[2 Marks]

**(b)** One hundred families are living in a rural village where they couldn't have grid electricity. But geological survey data concluded that nearby site has the potential of constructing a hydropower station where it contains a natural water reservoir with the elevation around 70 m head. Suppose that you are going to present a proposal based on the selection of a suitable hydropower plant. How you manage to prepare it?

[3 Marks]

**(c)** What are the factors that should be considered when selecting a good geothermal power plant?

[2 Marks]

**(d)** What are the main types of geothermal power plant? Briefly describe the operation of each type.

[3 Marks]

- Q3. (a) Provide a brief explanation of how wind speed varies with height at a given location (Use diagrams where necessary). [2 Marks]
- (b) A wind turbine with a blade length of 50 m is exposed to a wind speed of 12 ms<sup>-1</sup>. Assuming a turbine efficiency of 40% and density of air = 1.16 kg/m<sup>3</sup>, calculate the power generated by the wind turbine. [2 Marks]
- (c) A sales engineer from a company manufacturing wind turbines tries to sell you their latest wind turbine design stating that it has a power coefficient of 0.65. How would you respond? Would you recommend this product to your management? Explain. [3 Marks]
- (d) Draw a typical power curve of a wind turbine. Discuss the power curve in detail with emphasis on the relationship between different wind speeds and power generation characteristics. [3 Marks]

Q4. The ocean is the world's largest solar collector and can provide huge amount of energy (kinetic and thermal) which is absolutely clean, sustainable, strategic, and predictable.

- (a) What are the main sources used to extract the ocean energy? Briefly describe each of them. [5 Marks]
- (b) A 40 MW Tidal Barrage Scheme Plant is estimated to construct by choosing a location among the X, Y and Z sites. Table Q4. (b) shows the specifications related with each location. Find out the best suited location for the construction considering the daily average power generation. Explain why you choose that. (Take low tide potential energy is zero)  
 $g = 9.81 \text{ m/s}^2$  - gravitational constant  
 $\rho = 1025 \text{ kg/m}^3$  - density of seawater [3 Marks]

Table Q 4. (b)

	Location X	Location Y	Location Z
Capacity Factor ( $\eta$ )	0.3	0.4	0.45
Area of Tidal Pool (A)	12 km <sup>2</sup>	6 km <sup>2</sup>	10 km <sup>2</sup>
Range of the Tide (R)	9 m	12 m	6 m

- (c) Compare and contrast the difference between an open cycle OTEC system and a closed cycle OTEC system. Use appropriate diagrams. [2 Marks]
- Q5. (a) Provide a brief description of the different components of solar insolation. [2 Marks]
- (b) A certain amount of the solar radiation entering the earth's atmosphere is not available for utilization at the Earth's surface. Do you agree? Provide a brief explanation using diagrams where necessary. [5 Marks]
- (c) Discuss the technological features of a Flat Plate Collector (FPC). [3 Marks]