UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 7 Examination in Engineering: October 2019

Module Number: ME 7312 **Module Name: Energy Technology**

[Three Hours]

[Answer **all questions**, each question carries ten marks]

All assumptions must be stated clearly. Sketches and diagrams are to be provided where required. Symbols stated herein denote standard parameters.

Q1 "About three-quarters of the world's commercial energy demand is generated from fossil fuels and the rest is supplied from nuclear energy and renewable energy sources"

a) With the aid of a neatly drawn sketch, briefly explain how Fossil Fuels are formed.

[2.0 Marks]

b) What are the Advantages and Disadvantages of Nuclear Energy?

[2.0 Marks]

c) Draw a Light-Water-Moderated and Cooled Nuclear Power Plant with Water Reactor and briefly explain its operation.

[4.0 Marks]

d) Explain the nuclear fuel cycle with the help of fuel cycle diagram.

[2.0 Marks]

Q2 "It is estimated that about 5% of the households in Sri Lanka will eventually have to be supplied through Off – Grid Electrical Power Systems. Pilot studies have been conducted to identify viable Off – Grid Power Generation options for Rural Communities using biomass based power generation technologies. However, the expected performance from such systems have not been achieved"

a) Identify and discuss a small scale biomass based power generation technology applicable for Off – Grid Electricity Generation in rural areas.

[3.0 Marks]

b) State three major factors that you would consider when assessing the feasibility for an Off – Grid biomass based power generation project.

[2.0 Marks]

c) Discuss how the factors identified in Q2.b) above, will contribute towards the success or failure of the project.

[3.0 Marks]

d) Provide a brief description of Biomass Integrated Gasifier / Gas Turbine (BIG/GT) Technology.

[2.0 Marks]

Q3 a) What do you think the selection of the Sun as an energy source? Describe this with suitable details briefly.

[2.0 Marks]

b) Describe following solar angles with suitable clear sketches.

i) Declination Angle
ii) Zenith Angle
iii) Altitude/Elevation Angle
iv) Azimuth Angle

[2.0 Marks]

c) Solar tracking mechanisms are widely used in the world to extracts more energy from the Sun. Describe the types of solar tracking briefly with suitable sketches.

[2.0 Marks]

d) The ocean is considered as the world's largest solar collector and can provide huge amount of energy (kinetic and thermal), which is absolutely clean (zero CO_2 emission), sustainable, strategic, and predictable. Discuss five (5) ocean energy extraction methods with the aid of suitable details and sketches.

[2.0 Marks]

e) A wind turbine, (or wind energy converter), is a device that converts the wind's kinetic energy into mechanical energy and then to electrical energy. Discuss the main four types of wind turbines (According to the axis arrangement and blade design) available in the world.

[2.0 Marks]

Q4 a) The sun provides a tremendous resource for generating clean and sustainable electricity without toxic pollution or global warming emissions. To extract the energy, photovoltaic (PV) solar cells or concentrating solar thermal plants are widely used in the world. Discuss four major environmental impacts of above two technologies.

[3.0 Marks]

b) The proposed Uma Oya Multi-purpose Development project is an irrigation and hydroelectric complex in Sri Lanka and subjected to be controversial because of the environmental impacts of the project. Discuss four major environmental and social impacts of this kind of multi-purpose projects.

[2.0 Marks]

c) Oceans are a source of renewable energy, with the potential to contribute to a more sustainable energy supply in the future. But the technologies which are used to harness energy have a number of environmental impacts. Discuss briefly six environmental impacts of ocean energy extracting technologies.

[3.0 Marks]

d) What is Minamata disease? Briefly explain the reason of Minamata disease.

[2.0 Marks]

Q5 a) If you are assigned to develop a proposal for an Ocean Thermal Energy Conversion (OTEC) plant in Sri Lanka as a Mechanical and Manufacturing Engineer and you have to organize a feasibility study on that. Discuss the breakdown of the way of conducting feasibility study and parameters to be considered for that.

[3.0 Marks]

b) Dams store water from melting snow and rainfall in reservoirs (fuel), which is then released and passes through turbines to generate electricity. The water can be reused over and over as it moves downriver through multiple dams and turbines.
What are the types of dams mostly available in Sri Lanka? Discuss three (3) of them briefly with suitable details and sketches.

[3.0 Marks]

c) The amount of hydro power generation from a turbine is mainly determined by five parameters. Also, two of them describe the type of turbine (categorization of turbine) of the hydro power plant.

i) Describe those two (2) parameters and give examples according to the change of parameters.

ii) According to the geographical arrangement of Sri Lanka, what kinds of turbines are suitable for hydro power generation? Provide justifications for your selection

[4.0 Marks]