MASENO UNIVERSITY

UNIVERSITY EXAMINATIONS 2016/2017

THIRD YEAR FIRST SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE AND BACHELOR OF EDUCATION SCIENCE WITH INFORMATION TECHNOLOGY

MAIN CAMPUS

SPH 304: PHYSICS OF THE ENVIRONMENT AND ENERGY RESOURCES

Date: 2nd December, 2016 Time: 3.30 - 6.30 pm

INSTRUCTIONS:

- Answer question ONE and any other TWO questions.

SPH 304: PHYSICS OF THE ENVIRONMENT AND ENERGY RESOURCES

INSTRUCTIONS

Attempt Question **One** and any other two in this paper.

QUESTION ONE (30 marks)

a) State the chemical reactions that produce energy in the Sun (2 marks)
b) Name three water energy resources (3 marks)
c) What is meant by the term solar constant (2 marks)
d) What role is played by ozone layer in the atmosphere (3 marks)
e) Explain what is meant by global warming and how it is caused? (3 marks)
f) Explain how the dry air adiabatic and saturated adiabatic lapse rates affect movement of air in the atmosphere (4 marks)
g) Name the three lower layers of the atmosphere (3 marks)
h) What causes global wind? (2 marks)
i) State two advantages of solar energy over other renewable energy sources(2 marks)
j) What are the main hazards of nuclear power (3 marks)
k) How are thunderstorms caused? (3 marks)
l) With respect to wind energy, what is meant by the Betz limit? (2 marks)

QUESTION TWO (20 marks)

a) Given that the atmospheric pressure at sea level is $1.01\times10^{5}\,Pa$, compute average density and total mass of the atmosphere (take atmospheric thickness $h=100km$, radius of earth $R_E=6400km$, gravitational acceleration $g=9.81m/s^2$)(7 marks)

ii) Given that the sun-earth distance is $1.5\times10^{8}\,km$ and that the radius of the sun is $7.5\times10^{5}\,km$, estimate the temperature of the sun using the concept of solar Constant. (5 marks)

b) Calculate the heat lost per unit time through a glass window of surface area 2.6 m^2, thickness 5.0 mm and thermal conductivity $k=1.2W/mK$ given that the temperatures inside and outside the room are 18 °C and - 2 °C respectively. (5 marks)

ii) Hence calculate the heat resistance of the window (3 marks)

QUESTION THREE (20 marks)

a) Explain what is meant by Coriolis force with reference to the formation of global wind (5 marks)

b) You plan to climb to the top of Mt Elgon (height 3954m) from a camp site of elevation 1000m where the temperature is $5^{\circ}C$. What temperature do you expect at the top of the mountain? (Take dry air adiabatic lapse rate is $0.01^{\circ}Cm^{-1}$) (7marks)

c) A power plant converts the energy of tides,with tidal range R = 5.2 m, into electrical energy. What is the maximum power per unit area of the collecting basin that can be extracted? (take density of water to be $1.0\times10^{3}kg/m^{3}$) (8 marks)

QUESTION FOUR (20 marks)

a) What is the maximum amount of power that can be generated by a domestic wind mill with horizontal rotor blade radius 1.5 m in a horizontal wind of average speed 3.1 m/s assuming efficiency to be 40 % (take density of air to be 1.2 kg/ m^3) (6 marks)

b) Energy in the wind can be used to perform mechanical work which in turn can be used to generate electricity. Define perturbation factor of wind power extraction. (6 marks)

c) A solar cell of area 25 m^2 having a peak current and voltage of 5 mA and 500mV respectively is exposed to 1000 W/m^2 of solar radiation. Determine the efficiency of the cell. (8 marks)

QUESTION FIVE (20 marks)

a) i.The Niagara falls are approximately 52m high with a water flow rate of $6.0\times10^{3}m^{3}/s$. If all the gravitational potential energy of the water is converted to electrical energy,What is the power output of the plant?(take density of water to be $1.0\times10^{3}kg/m^{3}$) (4 marks)

ii. Given that the five H.E.Pstation at Niagara falls generate a total of 1800 MW. What is the efficiency of generation? (3marks)

b) Find the velocity as a function of time of a rain drop of mass m falling in air for which the frictional force is proportional to the square root of the drop's velocity. (13 marks)