JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

UNIVERSITY EXAMINATIONS FOR THE DEGREE IN SCIENCE IN RENEWABLE ENERGY TECHNOLOGY AND MANAGMENT

THIRD YEAR RESIT EXAMINATIONS 2020/21 ACADEMIC YEAR

CENTRE: MAIN CAMPUS

COURSE CODE: TET 3313

COURSE TITLE: Wind Energy Technology I

EXAM VENUE: **STREAM: BSc REN TECH & MGT**

DATE: ../11/2020 EXAM **SESSION:**

DURATION: 2 HOURS

Instructions

1. **Answer question 1 (Compulsory) and ANY other two questions**
2. **Candidates are advised not to write on question paper**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room**

QUESTION ONE **(30 marks)**

a) Explain the difference between energy and power **(2 marks)**

b) The equation of Power = ½ (Density)(Cross-sectional area)(Speed)^3 shows us what factors determine the power in the wind at different conditions. Briefly explain the conclusions that can be made from the equation **(6 marks)**

c) Briefly explain what is lift and drag forces and how the angle of attack affects these two forces **(4 marks)**

d) A turbine has three similar blades, each with the profile of the airfoil as and an aerodynamic force of 50lbs. Under the operating conditions the lift coefficient is 0.95 and the driving torque in the shaft is only due to the lift force. If the wind speed is 25 ft/sec and each blade is 22 ft long, find the torque generated in the shaft. **(5 marks)**

e) Electricity generation is the most important application of wind energy today. List six (6) major components of a commercial wind turbine **(3 marks)**

f) Name four (4) pumps used in mechanical wind pumping option **(2 marks)**

g) With reference to wind economics, discuss the operating and maintenance cost of a wind turbine **(8 marks)**

QUESTION TWO **(20 marks)**

a) Wind turbines are very beneficial in production of energy. However they have some environmental concerns attributed to them. Discuss four (4) environmental concerns of a wind turbine **(12 marks)**

b) In a blade with an airfoil profile the total aerodynamic force acting on the blade when wind speed is 25 ft /sec is 50 lb. The lift coefficient for this airfoil at the given angle of attack is 0.95. For the same angle of attack, if the wind speed changes to 40 ft /sec, find the lift force on the blade. **(4 marks)**

c) Briefly classify turbines based on their axis **(4 marks)**

QUESTION THREE **(20 marks)**

a) With regards wind turbine power, explain the power absorption by a wind turbine

(6 marks)

b) Wind speed as one of the aspects determining energy can in the wind can be affected by many factors, briefly explain what factors determine wind speed. **(12 marks)**

c) Briefly explain what an aerodynamic force is and its components **(2 marks)**

QUESTION FOUR **(20 marks)**

a) During the periods of extremely high winds, wind turbines should be completely stopped for its safety. In this regard, discuss the safety brakes of a wind turbine **(8 marks)**

b) Mechanical coupling of a piston pump with wind rotor makes the system simple and cost effective. However, the field performances of these units are not encouraging. In this regard, discuss the limitations of wind driven piston pumps **(12 marks)**

QUESTION FIVE **(20 marks)**

a) Discuss the several steps involved in the successful planning and development of a wind farm. **(12 marks)**

b) With regards to economics of wind, discuss the Initial costs of a wind energy project **(8 marks)**