



MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD YEAR SECOND SEMESTER EXAMINATION FOR
BACHELOR OF SCIENCE (APPLIED PHYSICS)

SPH 339: WIND ENERGY TECHNOLOGY

DATE: 6/12/2021

TIME: 11:00 – 1:00 PM

INSTRUCTIONS:

Answer question **ONE** which is compulsory and any other **TWO**

SECTION A (COMPULSORY)

QUESTION ONE (30 MARKS)

- a) Solar energy is the ultimate source of the renewable energies. Discuss (4 marks)
- b) Describe four ancient uses of wind energy (4 marks)
- c) Describe the following aspects concerning wind turbines
 - (i) The causes (2 marks)
 - (ii) The importance of lift force (4 marks)
- d) Describe any four types of wind turbines (8 marks)
- e) Discuss the historical aspects that have led to the re-emergence of wind energy in the global energy market (8 marks)

QUESTION TWO (20 MARKS)

- a) What is meant by the term airfoil (2 marks)
- b) Outline six possible disadvantages experienced in the exploitation of wind energy resource (6 marks)
- c) (i) Explain why an airfoil should not extract all the energy from the wind (4 marks)
(ii) Derive the expression for the Betz limit (8 marks)

QUESTION THREE (20 MARKS)

- a) Distinguish between wake and vortex (2 marks)
- b) Describe the effect of Reynolds number on an airfoil (4 marks)
- c) Based on wind flow before and after a turbine, describe the importance air circulation and formation of vortices. (5 marks)
- d) Distinguish between stall and pitch-regulated turbines (4 marks)
- e) Describe the blade element model of a wind turbine (5 marks)

QUESTION FOUR (20 MARKS)

- a) Distinguish between a wind mill and a generator. (2 marks)
- b) Name and explain the functions of any five major parts of a wind turbine generator (10 marks)
- c) Explain four advantages of modelling in the assessment of the wind energy potential within a certain region (8 marks)

QUESTION FIVE (20 MARKS)

As a renowned wind resource specialist, you have been requested to identify a site for a wind farm project from a pool of sites from different countries. Explain the considerations that would influence your choice?