



MACHAKOS UNIVERSITY

University Examinations 2022/2023 Academic year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (APPLIED PHYSICS AND TECHNOLOGY)

SPH 339: WIND ENERGY TECHNOLOGY

DATE: 12/4/2023

TIME: 8:30 – 10:30 AM

INSTRUCTIONS:

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

SECTION A

QUESTION ONE (COMPULSORY)

- (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) Solidity (2 marks)
 - (ii) Lift force and its importance (4 marks)
- (d) Describe the effect of Reynolds number on an airfoil (4 marks)
- (e) Distinguish between stall and pitch-regulated turbines (4 marks)
- (f) Describe any four types of wind turbines (8 marks)

SECTION B

QUESTION TWO (20 MARKS)

- (a) Define 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) Based on wind flow before and after a turbine, describe the importance air circulation and formation of vortex (5 marks)
(c) Describe the blade element model of a wind turbine (5 marks)
(d) Discuss the historical aspects that have led to the re-emergence of wind energy in the global energy market (8 marks)

QUESTION FOUR (20 MARKS)

- (a) Distinguish between a wind mill and a turbine (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)

You are the leader of a consortium of renewable energy experts interested in investing in a wind farm project. Describe the considerations that would influence your choice of site for the wind-farm?