



MAASAI MARA UNIVERSITY

**REGULAR UNIVERSITY EXAMINATIONS
2023/2024 ACADEMIC YEAR
THIRD YEAR, SECOND SEMESTER**

**SCHOOL OF PURE, APPLIED AND HEALTH
SCINCES
DEPARTMENT OF MATHEMATICS AND
PHYSICAL SCINCES**

COURSE CODE: PHY 3220-1

COURSE TITLE: ELECTROMAGNETISM

DATE:03/6/24

TIME:1100-1300HRS

INSTRUCTIONS TO CANDIDATES

Answer QUESTION ONE AND ANY OTHER TWO.

Read, understand and adhere to all exam rules and regulations at the back of your booklet.

Use of diagrams and illustrations where applicable are highly encouraged.

This paper consists of 3 printed pages. Please turn over.

QUESTION ONE (20 MARKS)

- a) Briefly explain how electromagnetic brakes based on eddy current principles work. Don't forget to mention where these brakes are applied. **(3 marks)**
- b) Briefly explain the physical meaning of any two Maxwell's equations of light. **(3 marks)**
- c) How can we explain the reason why hilly regions like Kisii land are prone to power blackouts during storms? Explain your answer in the context of electromagnetic principles you learnt this semester. **(3 marks)**
- d) State Lenz's law and give one real-life application of the law. **(3 marks)**
- e) Mathematically state Faraday's law, explain the terms thereof and explain a practical application where the law is applied. **(3 marks)**
- f) Explain the magnetic vectors **B**, **H** and **M**. **(3 marks)**
- g) A generator produces 24.0 V when turning at 900 rev/min. What emf does it produce when turning at 500 rev/min? **(2 marks)**

QUESTION TWO (15 MARKS)

- a) Starting from the four Maxwell's equations in their differential form, show that light is an electromagnetic wave. **(10 marks)**
- b) From your final equation in (a) above, articulate why light can be propagated in a vacuum unlike other mechanical waves. **(3 marks)**
- c) Briefly discuss the principle upon which 'solar sailing' technology is anchored. **(2 marks)**

QUESTION THREE (15 MARKS)

- a) Write down the mathematical expression of Poynting vector, hence explain its **physical** meaning. **(3 marks)**
- b) When giving presentations, many people use a laser pointer to direct the attention of the audience to information on a screen. If a 3.0-mW pointer creates a spot on a screen that is 2.0 mm in diameter, determine the radiation pressure on a screen that reflects 70% of the light that strikes it. The power 3.0 mW is a time-averaged value. **(4 marks)**
- c) A Marconi antenna, used by most AM radio stations, consists of the top half of a Hertz antenna (also known as a half-wave antenna because its length is $l/2$). The lower end of this Marconi (quarter-wave) antenna is

connected to Earth ground, and the ground itself serves as the missing lower half. What are the heights of the Marconi antennas for radio stations broadcasting at (a) 560 kHz and (b) 1 600 kHz? **(8 marks)**

QUESTION FOUR (15 MARKS)

- a) State Stoke's theorem **(2 marks)**
- b) Write wave equation in transmission line, how does it compare with the wave equation in free space. **(4 marks)**
- c) Discuss how electromagnetic waves can be generated from an antenna. **(5 marks)**
- d) Differentiate between self and mutual inductance. **(4 marks)**

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